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DEFENCE, MAN-POWER AND RESOURCES

THE appearance of the Defence Estimates for 1950–51, together with a White Paper on Defence*, has provoked widespread discussion. The real question to be asked, however, should not be how much the defence programme costs, but whether it is technically—and it might be added psychologically—adapted to serve its major purpose of averting war. This is precisely the question on which the Government is still silent and the one with which scientific men are most closely concerned. A marked feature of this year's White Paper on Defence is the extent to which the production of weapons and research into them is beginning to dominate questions of defence policy and expenditure. It is clear from the new estimates that the present decision is to concentrate a higher proportion of resources upon research and development. Thus, while the Royal Navy will decline in size by about 20,000 men, it will spend another £10,000,000 on production and research. The Royal Air Force is expected to remain at its present strength in men, but will spend an extra £13·5 million on research and development, and while the regular Army will decrease from about 185,000 to 178,000 men, it will spend £7,000,000 more on research. These increases more than offset the reductions in the pay bill, and research and development now represent 31·9 per cent of the defence estimates as against 24·1 per cent in 1948–49. Further, it must be accepted that budgetary provision for new equipment is likely to grow rather than diminish if the existing forces are to be kept reasonably efficient.

The Defence Research Policy Committee, of which Sir Henry Tizard is chairman, has the duty of framing general policy to govern research and development, and advises the Minister of Defence and the Chiefs of Staff on all priorities in research and development, in the light of the strategic requirements of the Chiefs of Staff. Together with the Advisory Council of Scientific Policy, it endeavours to secure the most economical use of the nation's scientific man-power and resources. Within the policy laid down by the annual report of the Committee the War Office, the Air Ministry and, to a lesser degree, the Admiralty formulate their requirements and transmit them to the Ministry of Supply. The execution of the research and development required by the Services is the business of the Ministry of Supply, the Vote of which bears the cost of expenditure on such work, the continuing cost of such research stations as the Royal Aircraft Establishment at Farnborough, and expenditure on basic research. The Admiralty is responsible for much of its own research and bears the cost directly on the Navy Vote. Much of the research work carried out by the Ministry of Supply is valuable for civil as well as military purposes, and to give a complete account of expenditure on defence it is necessary to make an apportionment of expenditure on the basis of estimated advantage to the defence and civil sides.

* Statement on Defence, 1950. (Cmd. 7895.) Pp. 14. (London: H.M. Stationery Office, 1950.) 4d. net.

Two reports of the Select Committee on Estimates for the session 1948–49 dealing with defence estimates commented on the difference of identity, both in production and in research and development, between the principal who defines policy and the contractor who carries it out. Responsibility for planning and forethought, on one hand, and responsibility for detailed estimate, execution and accountancy, on the other, do not rest with the same department. Nor does it appear that in practice the Minister of Defence remedies this defect, or does anything to secure the correlation of departmental production programmes. The Select Committee points out that the gross figure of £38·15 millions against "Research and Production" under "Ministry of Supply" does not indicate the re-imbursements by the Service Departments for deliveries to them, and it sees no reason why the net cost of all research, development and production work done for the Services by the Ministry of Supply should not be shown in future. With estimates mounting, it is essential that full information should be available if Parliament is to maintain effective control over expenditure reaching nearly 40 per cent of the total national expenditure on defence.

There is an even more serious obstacle to parliamentary and public scrutiny. Since the War, no details of expenditure on research and development, or of works services for the Service Departments, have been given in either the defence budget or in the estimates. The Select Committee quotes in its report from a Treasury memorandum submitted to the Select Committee for the session 1946–47 referring to the omission of such details for reasons of security, and suggesting that details should be given for important items in a confidential statement where required. The Select Committee is manifestly unhappy about this weakening of public control, and questioned Sir Henry Tizard on the subject. Sir Henry Tizard said that he would welcome an opportunity of being able to speak quite frankly to a committee such as the Select Committee on Estimates or an *ad hoc* committee and to answer any questions. He thought it was very valuable to get criticism from people looking at a problem afresh, and one could not get criticism if one was not in a position to answer questions. Incidentally, Sir Henry not only made it clear that he would welcome greater detailed examination by members of Parliament, but also indicated that he did not expect a very considerable increase in the research and development estimates. He also expressed the view that there is no considerable overlap in research between the Ministry of Supply and the Admiralty; he believes that unification of the Services in research and development is in practice much more effective in Britain than in the United States.

In spite, however, of Sir Henry Tizard's encouraging attitude, after subsequent discussions with the Minister of Defence, the Committee accepted the wish of the Minister that for reasons of security it should not investigate certain aspects of defence expenditure involving considerable sums of money. This decision does not prejudice any action that future Select Committees on Estimates may wish to take; but it raises a fundamental principle affecting the parliamentary control of expenditure. The present Committee recommends that the question should receive further consideration and that an early decision should be reached on the manner in which the House of Commons may be provided with adequate means of controlling all items of expenditure included in the defence estimates.

The importance of this question is stressed by the content of the new White Paper. The projected increase in expenditure of nearly £35 million on equipment and research in 1950–51 compared with 1949–50 brings the net total to £249·75 millions in a budget of £780·82 millions. This increase is stated to be largely on account of equipment and stores, but there is no information in the White Paper about even the general trend of research in any of the three Services, apart from the statement that air defence and anti-submarine research are receiving much attention.

Beyond this, the White Paper repeats the comment from last year's statement that the research and development programme is co-ordinated, and priorities are determined, on the advice of the Defence Research Policy Committee. This is followed by the significant admission that the full list of problems that the Services would like solved would require a far larger part of the total scientific and technical effort of the country than can be justified. It is therefore a question of selecting those projects the solution of which is most vital to our defence and which seem most likely to be achieved within a reasonable period.

The White Paper indicates some of the broad principles on which the defence policy of Great Britain is based: the assumption that we should not stand alone in resisting aggression; the retention of national service to build up a large reserve of trained man-power and to supplement the numbers required in the Services, particularly in the Army and the Air Force, which can be raised by recruitment of regulars; and the rejection as impracticable of a scheme by which a smaller number of men, selected by ballot or otherwise, would be required to serve for a period of eighteen months or more. Implicit in the statement, too, is the assumption that the Government believes that the balance between the three Services is roughly correct, and that it is satisfied with the position of the Western European Defence Organisation.

It may be taken as axiomatic that a co-operative as opposed to an isolated defence policy offers no possibilities of economy at a time when the whole system must be strengthened. This is indicated in the White Paper, which nevertheless is vague on such matters and does not touch on the crucial question as to how far national armies and air forces are being welded into cohesive international units. It is a certain air of unreality in these respects that makes public discussion important. The issues, in fact, are not solely for the technical experts, and the decisions required may well be, as Dr. J. B. Conant suggests in a highly pertinent recent article "Science and Politics in the Twentieth Century" in *Foreign Affairs* of January, best taken by laymen who understand science and scientific men, and who are familiar with engineering and engineers.

The public concern with the question of the hydrogen bomb is only one among a number of problems which bring into dispute the very principles upon which defence policy is at present based, particularly that of building up large reserves as opposed to the maintenance of an adequate effective striking force for immediate action. Fundamentally, this is a question of balance, and if adequate information cannot be given for effective public debate, then the secret session of Parliament suggested by Mr. Churchill on March 16 may be unavoidable. Moreover, the question of balance runs right through the issues involved in the distribution of resources of materials and of limited man-power, and cannot be determined by considerations of defence alone apart from the long-term needs of both peace and war. Here, above all, public debate is imperative. That there are clear limits to the extent to which any country can dispose of its resources in the preparation for war is becoming obvious to all and is recognized even in so powerful a country as the United States.

Then, again, a defence policy cannot wisely be based on the assumption that the atomic and hydrogen bombs have not revolutionized, at any rate, the opening phases of any future war, and that, whatever the limitations of such weapons in actual practice as decisive factors, they may, for example, by wrecking a country's communication system, make conventional mobilization impossible or unnecessary.

We cannot, in fact, ignore the possibility that the day of trained reserves may be past, any more than we can disregard the possibility that the atom bomb may never be used in war. What is clear is that these and other dilemmas with which the growing demands of research and development confront us must be faced with imagination and vision as well as technical knowledge. We cannot afford to go to war without the latest weapons, and our only chance of preventing the mounting cost of research and development from disrupting our whole economy, and diverting scientific and technical effort from the fields in which it is so imperatively needed for our economic recovery, is to eliminate the expenditure of money and effort on Service projects that have become irrelevant.

The problem is to determine what is irrelevant, and here it is well to bear in mind Dr. Conant's comment that we have yet to devise even approximately satisfactory procedures for evaluating technical judgments on matters connected with national defence, including atomic energy, and for determining the answers to such complex questions as to whether a large amount of public money is to be spent on the development of a given weapon or its auxiliary. The dilemma was fully recognized in the debate in the House of Commons on the defence estimates on March 16, and, although the idea of a secret session in time of peace is unattractive and crude, it should not be rejected forthright without some attempt to advance a constructive alternative proposal.

The debate was, on the whole, much more realistic than the White Paper, but it added very little to our knowledge and gave no assurance that the right answers had been found. There was, for example, manifest dissatisfaction with Mr. Shinwell's assurance regarding the hydrogen bomb that "The Chiefs of Staff are giving full weight to this new military factor". As to research and development, he could only say that the main problems on which British scientific men and technicians are engaged are the development of atomic weapons, jet bombers and fighters, including preliminary work on aircraft flying at speeds greater than that of sound, the development of turbo-jet engines and guided missiles both for offensive and defensive purposes, radio and radar developments, while in the field of naval research the highest priority is being given to the development of anti-submarine devices and equipment.

The House recognized the necessity for reticence on such matters. But nothing could illustrate better the flimsiness of the claim that the Minister of Defence has secured co-ordinated and balanced planning by the three Services in co-operation and an efficient defence organisation than the fact that, after a single day's debate on the defence estimates as a whole, which left unanswered the great questions about balance and the alignment of policy and commitments with resources, Parliament proceeded to debate the estimates for the three Services separately.

This realistic debate was nevertheless described by the Prime Minister as one of the best debates on defence, and it certainly showed that on all sides of the House there is real consciousness both of weaknesses in our present policy and of the failure hitherto of the Ministry of Defence in our defence requirements. There was, too, a general desire to see defence policy effectively concerted as part of a system of Western European Defence and aligned alike with our commitments and our economic, scientific and man-power resources. Speakers like Mr. Paget and Brigadier Head did not lightly accept the views that the present balance of forces is satisfactory, that the reliance on trained reserves is wise and that an alternative to the present national service principle would not give us greater security and the ability to make an effective contribution in the early stages of a war. The subsequent speech of the Secretary of State for War suggests that to some extent he agrees with and appreciates the force of that argument; but the place for such discussion is in the debate on defence as a whole and not in a debate on separate aspects of defence before Parliament has been satisfied on the broad lines of policy.

The main point, however, is that with a defence expenditure of £800 millions a year, no secrecy requirements can be allowed to stand in the way of satisfying the nation, at least through its representatives in Parliament, that the right policy is being followed and the right priorities observed. This need must transcend all question of party loyalties, and the very narrowness of the Government's majority should make it easier to meet the need. Moreover, the magnitude of the scientific and technical resources involved makes it imperative also to find a means of satisfying responsible scientific and technical opinion that the right compromises have been adopted. Here it does not seem impossible that some use might be made of the services of the Parliamentary and

Scientific Committee in working out a means by which both Parliament and public opinion could be satisfied and effective discussion of the real issues proceed without public danger.

These, of course, are the aspects of defence with which the scientific man and technologist are most closely concerned, and they will be aware of the large demands for vision and imagination which will be made on the new Minister of Defence. It is not only —or even chiefly—on the Minister of Defence that there falls the responsibility for clear thinking and plain speaking if we are to achieve an effective system of collective defence; on the Cabinet as a whole falls the responsibility for making plain to our partners in defence the exact form which our contribution to the common defence will take, and the limitations dictated by our resources in material and man-power. The nature of that contribution will be determined in part, moreover, by the innumerable practical difficulties which arise in regard to common equipment and its standardization and manufacture, on which the welding of separate national forces into a coherent defence force of effective striking power depend. Many such questions must be answered before, and not after, defence policy is formulated.

SURVEY OF ANTIBIOTICS

Antibiotics

A Survey of Penicillin, Streptomycin, and other Antimicrobial Substances from Fungi, Actinomycetes, Bacteria and Plants. By Sir Howard Florey, Dr. E. Chain, Dr. N. G. Heatley, Dr. M. A. Jennings, Dr. A. G. Saunders, Dr. E. P. Abraham and Lady Florey. (Oxford Medical Publications.) Vol. 1. Pp. xv+628. Vol. 2. Pp. vii+629–1774. (London, New York and Toronto: Oxford University Press, 1949.) £8 8s. net.

IN 1876 John Tyndall, the British physicist, recorded in a paper on "Optical Deportment of the Atmosphere in Relation to the Phenomena of Putrefaction and Infection", published in the *Philosophical Transactions of the Royal Society*, what is probably the first description of the antagonistic action of a species of *Penicillium* to bacterial growth, though he erred in attributing this action to the mould "seriously intercepting the oxygen said to be necessary to bacterial growth". In the following year, Pasteur and Joubert gave the first clear description of bacterial antagonism when they showed that a common aerobic bacterium inhibits the growth of anthrax bacilli in sterile urine. Vuillemin in 1889 introduced the term antibiosis, and Marshall Ward ten years later gave his blessing to the use of this word in reference to microbial antagonism, adopting it to describe the converse of symbiosis.

According to the "Shorter Oxford English Dictionary" the word antibiotic (rare, 1860), means "opposed to a belief in the presence or possibility of life". It was adopted in 1945 by S. A. Waksman, who defined it as "a chemical substance produced by micro-organisms which has the capacity to inhibit the growth of bacteria and other micro-organisms and even to destroy them". This definition is accepted by the authors of the present book, who, although they also include plant products in their comprehensive review, are careful to describe them as anti-microbial substances. With this historical background it is regrettable to note a growing tendency to give a different shade of meaning to the word. Commenting on the synthesis of chloromycetin, the antibiotic produced by *Streptomyces venezuelæ*, the *British Medical Journal* (1, 672; 1949), in an editorial states that "hitherto the term antibiotic has been applied only to naturally occurring substances *endowed with chemotherapeutic powers* [my italics] and produced by micro-organisms during their growth and metabolism". It is my opinion that this restrictive application of the word to those antibiotics possessing curative properties is contrary to established scientific procedure and historical accuracy.

During the past few years a large variety of comprehensive reviews and books on different aspects of antibiotics has appeared in a number of languages. They have ranged from the semi-popular 'best seller' to the severely scientific text-book. It is therefore peculiarly appropriate that the most complete and scholarly production of them all should have been compiled by the combined efforts of the Oxford team of scientific workers, headed by Sir Howard Florey, who first established the tremendous importance of penicillin in clinical medicine and thus provided the impetus to the now world-wide investigations on antibiotics. This very fact, however, made difficult the authors' original aim of collecting together in one volume all the available information on all antibiotics, whether such work were chemical, microbiological, pharmacological or clinical. They have in part overcome this difficulty by publishing in the present Vols. 1 and 2 mainly the results of laboratory investigations, leaving to a future Vol. 3 the clinical applications of antibiotics. Even so, it has been necessary to add an appendix of some thirty-five pages to bridge the gap between the completion of the manuscript and the correction of proofs.

The first volume is divided into seven parts. The first part, erudite but nevertheless making very fascinating reading, serves as a historical introduction, and brings the whole subject into proper perspective. There follow sections on: general experimental methods; antibiotics from fungi, giving a review of species of fungi examined and of antibiotics, other than penicillin, isolated from fungi; antibiotics, other than streptomycin, isolated from actinomycetes; antibiotics from bacteria; and anti-microbial substances from lichens, algæ and seed plants.

The second volume has four parts dealing respectively with penicillin, streptomycin, the action of antibiotics on bacteria, and general conclusions. It closes with an appendix and tables of antibiotics, a bibliography of eight-four pages, and author and subject indexes. The section on penicillin deals in an authoritative manner with every aspect of the subject except the clinical aspect. It includes chapters on the production, extraction and purification of penicillin, its chemistry, structure and synthesis, its effects on micro-organisms and its pharmacology. Similarly, streptomycin is exhaustively discussed from the production, chemical, microbiological and pharmacological angles. The last chapter, which is devoted to general conclusions, summarizes in a masterly fashion the authors' considered opinions of the progress made in the subject during the past decade, together with their views on present and future trends.

About eighty well-defined antibiotics are described in the two volumes, besides many hundreds of active

principles which have not yet been characterized. A number of them have such outstanding biological properties, for example, their marked specificity and the fact that they show their effects in such extremely minute concentrations, that in pre-penicillin days they would have been regarded as quite remarkable substances. As would be expected from our knowledge of other microbial metabolic products which have no antibiotic properties, the antibiotics also show an almost bewildering variety of chemical structures. Hence, apart from the proved practical importance of a few of them in clinical medicine, they are clearly of great interest to research workers in a number of fundamental sciences. This point of view is aptly summarized (p. 1511) and is quoted, since it admirably expresses the philosophy of the authors themselves. "These considerations (i.e., the possibility of discovering new clinically important antibiotics) should not be allowed to obscure the more academic side of the subject. Pursuit of fundamental knowledge of microbial antagonism is resulting in the discovery of new substances whose chemical structure and biological specificity are alone of sufficient interest to compensate, in some measure, for the labour and difficulties involved in their isolation. It is also leading to a large accumulation of data which, though at present unexciting, may some day, like observations on morphology, find a place in a coherent account of the varied activities of living cells."

The two volumes are assured of premier place in the libraries of those interested in antibiotics.

HAROLD RAISTRICK

DEVELOPMENT AND BEHAVIOUR OF MAN

About Ourselves

Man's Development and Behaviour from the Zoological Viewpoint. By James G. Needham. Pp. xi+276. (London: George Allen and Unwin, Ltd., 1950.) 15*s.* net.

WRITTEN for laymen, this is a book which sets out to trace man's position in Nature and the fundamental zoological reasons for his being what he is and behaving as he does. The book is divided into two parts, the first tracing the structure, development and first steps in learning in man back to their sources in the animal world; the second investigates man's collective behaviour by comparing it with the behaviour of the more social animals. In the first part a short introductory statement about man's relation to the rest of the animal kingdom is followed by chapters on the primates, the growth of the nervous system and behaviour, infancy and the roles of heredity and environment in man's development. This section is admirably done, although the paucity of illustration is surprising.

In the second part, Dr. Needham discusses society in its biological aspects, and among the topics considered are population, social nurture, social behaviour, instinct in human affairs, the folk-ways, war, government and religion. Here one notes a real difference from the first part of the book, where the author's statements are demonstrably based on experiment and observation. The unsuspecting layman might assume that all the statements on the biological aspects of society are also based on evidence carefully collected through the years by men of science. Although much of the information in this part of the book could be substantiated, in several places a note might have been included to say that statements made were, at present, opinions which might not be shared by other men of science. The suggestion that man, in his present state of social development, must go to war periodically is one which, although shared by many men of science, has been rejected by a large number of anthropologists and psychologists. Needham's views on religion would also be challenged by many zoologists; in fact, it is open to question whether such a topic should have been included in a book the first part of which consists of information sufficiently factual to make a layman accept it as authoritative. Without explanation the layman might be led to accept the more controversial second part in its entirety as substantiated fact

T. H. HAWKINS

BIOCHEMISTRY OF PLANTS

An Introduction to Plant Biochemistry

By Dr. Catherine Cassels Steele. Second edition, revised. Pp. viii + 346. (London: G. Bell and Sons, Ltd., 1949.) 22*s.* 6*d.*

THE claim is made for the second edition of this book that it has been carefully revised and brought up to date. It is therefore unfortunate that many of the additions are slipshod and inaccurate. Little or no complaint can be made about such chapters as those on the chemical composition of plants, the colloidal state, alcohols, fatty acids, etc., in which the author is dealing with matter that has now become incorporated into the groundwork of our knowledge. Even here, however, the investigators quoted are treated in a cavalier manner. Names of authors are mentioned; but dates and the titles of their communications and the journals in which they have been published are conspicuous by their absence. This places the reader at a serious disadvantage; but perhaps it may be considered to have some basis in logic if pursued to the end.

Practical experimental exercises for the student to carry out are mentioned in a number of chapters. The majority of these experiments are well and clearly described; but the description of the Kjeldahl method of estimating total nitrogen is completely misleading. Not only is the addition of a catalyst not mentioned, but also the great importance of the time of digestion after the solution has cleared (and it will only clear if a catalyst is present) is not emphasized. Finally, no practical analyst would think of using the distillation apparatus illustrated, but would distil the mixture direct from his digestion flask.

The statements made about certain vitamins are confusing and inaccurate. On page 163 vitamin B_1 is correctly termed aneurin, but on p. 171 vitamin B_1 is also called aneurin. In fact, the whole description of the vitamin B_2 complex given here requires revision. Again, reference is made to vitamin B_2 or riboflavin, also on p. 171, as being a factor essential to the nervous system. This, of course, is not the case. Moreover, the best plant-sources of riboflavin are not green vegetables like spinach, lettuce and broccoli, but leguminous seeds.

It is a great pity that this otherwise excellent book should be marred by defects such as have been described. An adequate list of general references is given at the end of the book.

E. C. BARTON-WRIGHT

Tentative Study of the Pleistocene Climatic Changes and Stone-Age Culture Sequence in North-Eastern Angola

By Dr. L. S. B. Leakey. Companhia de Diamantes de Angola: Publicacoes Culturais, No. 4. Pp. 82. (Dundo, Angola: Museu do Dundo, 1949.)

IT is rare for a commercial company to take an interest in a purely cultural matter, and it is still rarer when money is expended on it. The Companhia de Diamantes de Angola and Mr. J. Janmart, the chief of the prospecting service, are to be congratulated on forgetting diamonds for a moment and turning their attention to the prehistory of Angola. Mr. Janmart, with a grant from the Company, attended the Pan-African Congress on Prehistory at Nairobi in January 1947, and there arranged that Dr. L. S. B. Leakey should visit Angola and report. This book is the result.

Naturally, as the result of only a short visit, the volume is necessarily general and tentative; much further detailed work will be necessary. But the evidence already obtained is encouraging. A number of sections were examined and stone industries discovered. Indeed, it has been possible to suggest a sequence and correlations with other known areas. The 'datum line' is the deposit of the Kalahari sands. The late Acheulean industries occur below the older Kalahari sands, which themselves contain the proto-Sangoan. The Middle Sangoan is found at the base of the Upper Kalahari sands. With such fixed datum lines it will be easy to fit in further details as they come to hand. Dr. Leakey and Mr. Janmart are to be congratulated on opening up a new area in African prehistoric research.

Niels Bjerrum

Selected Papers. Edited by friends and co-workers on the occasion of his 70th Birthday, the 11th of March, 1949. Pp. 295. (Copenhagen: Einar Munksgaard, 1949.) 18 kr.

IN a foreword to this handsome volume, Prof. Niels Bohr says that the editorial committee thought that an edition of a selection of his papers would be the most fitting way in which his colleagues could express the indebtedness which chemists and physicists owe to Prof. Niels Bjerrum. It is certain that many friends all over the world will be pleased with this birthday gift to the distinguished Danish chemist. Many of the papers reprinted, all of which are translated into English, have had a lasting influence on physical chemistry, and it is good to have them collected in this way. The frontispiece is an excellent portrait of Prof. Bjerrum. J. R. P.

The Lapwing

Written and illustrated by E. A. R. Ennion. (Field Study Books, No. 1.) Pp. xii+48+4 plates. (London: Methuen and Co., Ltd., 1949.) 6*s*. net.

IN this book on the lapwing Dr. E. A. R. Ennion shows that he has studied his subject with considerable care, and I have few criticisms to make, except that he might have told us rather more about this bird, popular as it is. One would have liked to have read his theory for its decrease everywhere in Great Britain, and its almost complete disappearance from some areas. One expected to have some account of the devastating effect on the species of that prolonged spell of frost and snow from January until March in the year 1947. Since that time, I do not think more than two pairs of lapwings have nested in all the Isle of Skye. But that Arctic spell, although it greatly accelerated the decrease of the species, does not altogether account for it, for the decrease was in progress before that date. Shall we some day be told that there is a Hebridean lapwing, ranking as a sub-species?

The nesting habits of the lapwing of the Hebrides are rather different, since it rarely nests on fields but usually out on the open moor, or on the machair. Hebridean lapwings cannot, I think, migrate as far as the birds of some upland mainland districts. Whereas the lapwing population of the Isle of Skye had been almost wiped out by the long-sustained cold spell of early 1947, the population in the high-lying and snowy district of the county of Lanark returned in force in the spring; the birds had perhaps migrated to Spain or to North Africa, for the frost was intense even in the south of Ireland.

The illustrations in black-and-white by the author are interesting, and some of them are very good; but the coloured plates have suffered in reproduction. SETON GORDON

Primulas for Garden and Greenhouse

By E. H. M. Cox and G. C. Taylor. Pp. vii+86+16 plates. (Oxford: B. H. Blackwell, 1947.) 7*s*. 6*d*. net.

THE genus *Primula* is certainly one of the most attractive and rewarding to any gardener worthy of his salt and lucky enough to live in a climate that suits the more difficult species. Its continued popularity is shown by the issue of a second edition of Messrs. Cox and Taylor's useful little book, first published in 1928. The new volume is virtually a reprint of the first edition, with the nomenclature and a few other necessary points brought up to date. It still provides a good introduction to the genus for gardeners; but it is a pity that the statement that "botanists will never cease arguing whether this [*P. elatior*, the oxlip] is a natural species or a cross between the Primrose and the Cowslip" should have been left uncorrected. J. S. L. G.

A Textbook of Physical Chemistry

By Dr. J. Newton Friend. Abridged and revised (second) edition. Pp. xv+566+7 plates. (London: Charles Griffin and Co., Ltd., 1948.) 42*s*. net.

THE first edition of Dr. Friend's book in two volumes has been valued by teachers and students as a very readable, accurate, and useful work. It filled a place not occupied by any other book. The new edition in one volume contains all the more advanced parts of the earlier work, and much new material. By using a very concise style and taking for granted some very elementary material, the author has contrived to pack into the volume a surprising amount of information, which nevertheless does not give the impression of undue condensation. This is probably because the author has thought everything out before writing, and has made full use of his real capacity for presenting information in an interesting way. All the topics included in courses on physical chemistry of degree standard are covered, and a very good feature of the book is the inclusion of a chapter on combustion in gases and many smaller sections on subjects of similar interest and importance, which are usually neglected in text-books. The book is one which every teacher and student will find useful. It is up to date and sufficiently detailed to be valuable for reference. The paper and printing are unusually good and there is a detailed index. J. R. P.

ABSORPTION SPECTRUM OF OXYGEN

By Prof. D. KEILIN, F.R.S., and Dr. E. F. HARTREE
Molteno Institute, University of Cambridge

IN a recent communication[1] we directed attention to the absorption spectrum of oxygen, which includes a number of sharp bands in the visible region. That this important property of oxygen is generally overlooked is not surprising since the interesting literature on this subject, although going back as far as 1883, has not reached text-books. In the present communication we are giving some further information on the early developments in this field, together with spectrophotographic and spectrophotometric records of liquid oxygen.

That oxygen shows selective absorption in the visible region was established by Egoroff (1883)[2], who recognized the *A* and *B* bands of the Fraunhofer spectrum (at 776·1 and 686·7 mμ) in the light transmitted by oxygen under pressures up to 15 atmospheres in a tube 20 metres long. Shortly afterwards, Janssen (1885)[3] made further spectroscopic studies of oxygen under higher pressures. Utilizing the very spacious accommodation of the Observatoire de Meudon near Paris, he was able to construct tubes up to 120 metres in length; but the longest tube used in his experiments with oxygen was one of 60 m., which he was able to fill to a pressure of 27 atmospheres. The bands that he described were at shorter wave-lengths than those recorded by Egoroff and bore no relationship to the Fraunhofer lines. He noted that the intensity of the bands in tubes of various lengths was proportional not to the product of tube-length (l) and pressure (p), but to lp^2, which has since become known as Janssen's Law. On the basis of this relationship he could calculate that the light absorption by the oxygen in a vertical column of the earth's atmosphere would be equivalent to that of a column of oxygen at atmospheric pressure only 172 m. long, although the quantity of oxygen traversed was far greater in the case of the earth's atmosphere. This square law relationship explained why these bands were not apparent in the solar spectrum. The most intense of these bands, which lies at 577 mμ, was just discernible in his 60-m. tube at an oxygen pressure of six atmospheres, which would be equivalent to $60 \times 6^2 = 2{,}160$ m. at atmospheric pressure. This latter figure is 12·5 times 172, and Janssen was able to carry out an elegant confirmation of his reasoning by detecting the 577 mμ band in sunlight in the clear atmosphere of the Sahara when, with the sun at an altitude of 4°, the effective depth of the earth's atmosphere was increased about twelve-fold[4].

By using a Zeiss comparison spectroscope which has a very small dispersion, we have been able to detect the band at 577 mμ with the sun at a higher altitude (23·5°), and to match it against the same band of oxygen under pressure in the 60-cm. steel tube previously described[1]. The match point was reached when the tube was filled to a pressure of 30 atmospheres, while a calculation made by Dr. A. D. Walsh on the basis of Janssen's Law gave a figure of 26 atmospheres. In view of the experimental difficulties and the approximations necessary for the calculation, this agreement is very satisfactory.

Fig. 1. Absorption spectrum of 5·2 cm. of liquid oxygen. 0·5 sec. exposure on Ilford Pan *F*. film

Absorption Spectrum of Liquid Oxygen

The work of Janssen was extended by Liveing and Dewar[5], who made a spectroscopic study of liquid oxygen and published a schematic figure of the absorption bands in the visible region. Although a number of workers have made a close study of the absorption bands of gaseous, liquid and solid oxygen, and have identified up to forty bands between 1,300 and 300 mμ (for references see our earlier paper[1]), no photographic or spectrophotometric results for the visible region have been placed on record.

Our interest in the absorption spectrum of oxygen arose when we were attempting to observe the spectra of pigments such as cytochrome and hæmoglobin in biological material which was cooled by immersion in liquid air. Using a microspectroscope or a direct-vision hand spectroscope for examination of liquid oxygen in an unsilvered Dewar vessel, we observed several very distinct bands in the visible region. These bands, according to more recent investigations[6,7], are due to tetra-atomic oxygen (O_4) in equilibrium with diatomic oxygen (O_2): $2O_2 \rightleftharpoons O_4$. Whereas liquid oxygen contains 50 per cent O_4, the O_4-content of the gas is less than 0·1 per cent at atmospheric pressure and rapidly increases with the pressure. Thus the bands at wave-lengths less than 650 mμ are due to tetra-atomic oxygen since they obey Janssen's law, while those at higher wave-length, including Fraunhofer *A* and *B*, belong to diatomic oxygen. Their intensities follow Beer's law at low pressures but will deviate from it, in the opposite sense to the Janssen bands, at higher pressures owing to the formation of tetra-atomic oxygen. In the solar spectrum the bands of oxygen that predominate are *A* and *B*, while in oxygen under pressure the Janssen bands are relatively stronger. The formation of tetra-atomic oxygen (O_4) can be followed by measurements of magnetic susceptibility, since diatomic oxygen is paramagnetic whereas tetra-atomic oxygen is diamagnetic. We should like to direct attention once more to the formation of diamagnetic oxyhæmoglobin by reversible combination of the two paramagnetic molecules, hæmoglobin and oxygen (O_2).

Using the photographic method already described[8], we have recorded the absorption spectrum in 5·2 cm. of liquid oxygen contained in a Dewar vessel (Fig. 1). An absorption curve at wave-lengths between 650 and 470 mμ was obtained with a Hilger–Nutting spectrophotometer. For this purpose (Fig. 2) the same Dewar vessel (*d*) was fixed vertically within a rectangular 'Perspex' box (*a*) standing between the light source (*e*) and the photometer (*f*). The box was

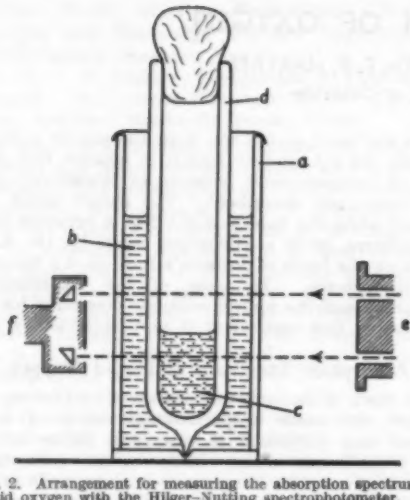

Fig. 2. Arrangement for measuring the absorption spectrum of liquid oxygen with the Hilger–Nutting spectrophotometer. For description see text

filled with water (*b*) containing a detergent (0·01 per cent 'Teepol') to prevent the accumulation of air bubbles in the optical paths, and liquid oxygen (*c*) was poured into the Dewar vessel so that only the lower light beam passed through oxygen. Errors arising from distortion of the optical path were corrected by means of a parallel experiment with liquid nitrogen. From the resulting curve (Fig. 3), it is seen that the maxima of absorption are at 631, 577, 532 and 477·5 mμ. These figures are more precise than those which were previously obtained using a microspectroscope[1] (the figure 577 was erroneously given as 557 in our previous paper). At least three of these bands can be clearly seen in 5 cm.

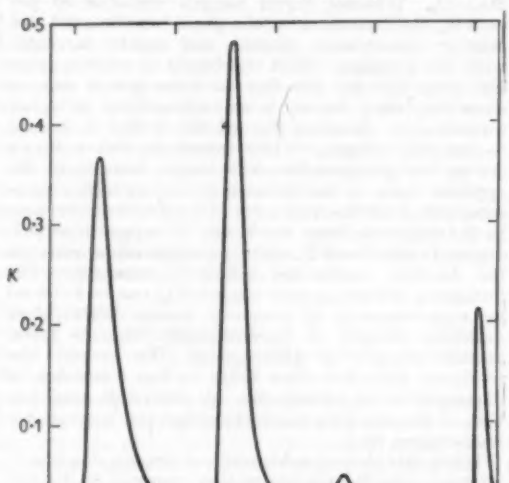

Fig. 3. Absorption curve of liquid oxygen; extinction coefficient $K = \frac{1}{l}\log_{10}\frac{I_0}{I}$; l is optical depth in cm., I_0 and I intensities of incident and transmitted light

of liquid air by means of a small dispersion hand spectroscope, in spite of the twenty-five-fold decrease in the intensity of bands resulting from the five-fold dilution with nitrogen.

It is hoped that the above observations and records will help to introduce this interesting phenomenon as a simple class demonstration for students of natural science.

[1] Keilin, D., and Hartree, E. F., *Nature*, **164**, 254 (1949).
[2] Egoroff, N., *C. R. Acad. Sci. Paris*, **97**, 555 (1883); **101**, 1143 (1885).
[3] Janssen, J., *C. R. Acad. Sci. Paris*, **101**, 649 (1885); **102**, 1352 (1886).
[4] Janssen, J., *C. R. Acad. Sci. Paris*, **120**, 1306 (1895).
[5] Liveing, G. D., and Dewar, J., *Proc. Roy. Soc.*, **46**, 222 (1889).
[6] Guillien, R., *C. R. Acad. Sci. Paris.*, **198**, 1486 (1934).
[7] Salow, H., and Steiner, W., *Z. Phys.*, **99**, 137 (1936).
[8] Keilin, D., and Hartree, E. F., [*Nature*, **165**, 504 (1950)].

MEDICAL RESEARCH COUNCIL

REPORT FOR 1945–48

IN its report on its war-time activities during the years 1939–45, entitled "Medical Research in War" (see *Nature*, **161**, 998; **1948**), the Medical Research Council recorded alterations of its normal programmes which were made to meet the needs of war. Now we have a report* which shows how the Council has, since the War, terminated some war-time activities which were no longer needed, continued others that are still required, and developed new ones related to the advance of scientific knowledge. This change back to normal activities has been effected in spite of various difficulties, among which shortage of accommodation has been an important handicap, now happily in process of removal by the occupation of the new premises of the Council at Mill Hill.

Among war-time activities that have ceased are the work of the War Wounds Committee, which did such outstanding work on the control of wound infections and other problems. As this report rightly says, no other field of war-time research has been so beneficial to mankind as the work of this Committee. The Penicillin Trials Committee completed its work with its determination of the effect of penicillin on subacute bacterial endocarditis, and was able to find conditions under which this disease could be cured. The Penicillin Synthesis Committee also achieved a great deal. Other committees which have been dissolved are those on brain injuries, traumatic shock, malaria, typhus, therapeutic requirements and military personnel. The Committee on Nerve Injuries, however, remains in being.

A good deal of war-time work is being continued, because it continues to have important relations to public life. The Public Health Laboratory Service, for example, which was initiated by the Medical Research Council at the outbreak of the War to counter possible bacteriological warfare, was taken over by the Ministry of Health as a permanent service. Its work is summarized in a section of this report. The fine work of its headquarters and constituent laboratories all over Great Britain covers such a variety of subjects of public importance that the report itself must be studied by those who wish to follow it in detail.

The Food-rationing (Special Diets) Advisory Committee continues its work, and is likely to be needed until food-rationing ceases. The Royal Naval Per-

* Report of the Medical Research Council for the years 1945–1948. (London: H.M. Stationery Office, 1949.) 5s. net.

sonnel Committee represents a different kind of work. The Board of Admiralty considered its work to be so valuable during the War that it was asked to continue its work during peace-time. It studies, through its various subcommittees, a wide variety of problems which affect the health, comfort, safety and efficiency of naval personnel. The work of the Medical Research Council on the treatment of flour by chemical substances which makes bread lighter in texture and colour, and more easily masticated, has received a good deal of publicity, and most people will now know that the use of 'agene' (nitrogen trichloride) in the preparation of flour has been discontinued.

The Physiology of Hearing Committee directed, before the War, much research upon deafness, which has been recorded in special reports issued by the Council. Since 1944 the Council has appointed an Electro-acoustics Committee, a Committee on Medical and Surgical Problems of Deafness and a Committee on the Educational Treatment of Deafness. The work of these committees on behalf of the half-million people in England and Wales who suffer from deafness is described in this report.

Of outstanding importance is the work of the two committees which are conducting trials of streptomycin against tuberculosis and non-tuberculous conditions respectively. It is impossible in a brief review to summarize the work of these committees, and it is, no doubt, too early yet to assess the full significance of it; but there can be no doubt at all of the great value of every kind of work on antibiotics of all kinds.

In the field of occupational health, the Council records valuable work on fluorosis, occupational skin diseases, burns, pneumokoniosis, the effects of organic solvents and other industrial hazards. A Unit for Research in Climate and Working Efficiency has been established at Oxford, the Applied Psychology Research Unit at Cambridge has been expanded, and a Social Medicine Research Unit is based upon the Central Middlesex County Hospital. Work upon occupational health has therefore been increased during the past three years to an unprecedented degree and now represents a substantial part of the whole programme of the Council.

Among the activities of the Council which bring its work into relation with new scientific developments is the work of the Committee on the Medical and Biological Applications of Nuclear Physics, which deals, through its subcommittees and panels, with the protection of man against the effects of radioactivity, the use of tracer elements, and the possible uses of radiations associated with atomic and nuclear disintegration for the treatment of cancer and other diseases. A good deal of space is devoted to it in this report.

The discovery by Prof. H. E. Shortt and Dr. P. C. C. Garnham of the pre-erythrocytic phases of *Plasmodium vivax* is here rightly given the prominence due to this outstanding advance of our knowledge of malaria, and the work which led up to it is outlined. Since this report was written, the same workers and their collaborators have discovered the comparable phases of *Plasmodium falciparum* (*Brit. Med. J.*, ii, 1,006; 1949). Another section of the report deals with research in the Colonies and the establishment of the Colonial Medical Research Committee. This Committee is helped by three subcommittees which deal with malaria, helminthiasis and nutrition. Their work, like other aspects of the activities of the Council, has been hampered by lack of suitable research workers. A Medical Research Liaison Committee for India has also been set up for the exchange of scientific information between Great Britain and India, and for co-ordination of the work being done in the two countries.

The many other activities sponsored by the Council in one way or another and recorded in this report cannot be dealt with here. There is, for example, the work on the common cold, in which the lay Press has naturally been much interested, and the many other lines of work outlined in the section of this report which records the programme of the National Institute of Medical Research. There are also the many researches at various other centres, which are aided in one way or another by the Council and are listed here. All these researches constitute a great body of valuable work, going on throughout Great Britain, which is an essential part of the general plan of the Council. The bibliographies here published of the work done with the aid of the Council show how wide and useful is all this work.

The Council has lost the services, during the period under review, of two distinguished members, Lord Balfour of Burleigh and Sir William Goodenough. Sir Percival Hartley, who built up and controlled the Department of Biological Standards of the National Institute for Medical Research, has also retired after twenty-five years of work for the Council. Even longer service has been given by Dr. Leonard Colebrook, whose work on sulphonamide drugs, the biology of the streptococci and the treatment of burns is well known. He retired in 1948. Beyond 1948 the report does not go; but biologists will know of the Council's loss of another of its veterans, Clifford Dobell, whose death occurred this year. It removes from the world one of its pioneer protozoologists.

Finally, the retirement of Sir Edward Mellanby, secretary of the Council, is indeed a grievous loss (see *Nature*, June 25, 1949, p. 986). No man has refuted more ably the view that a scientific man cannot be both a good investigator and a good administrator. His ability in the laboratory was long ago proved, and one glance at this report will reveal the quality of his administrative range and vigour.

G. LAPAGE

BIOCHEMICAL STUDIES OF THE WOOL ROOT

By W. J. ELLIS, J. M. GILLESPIE and H. LINDLEY

Biochemistry Section, Division of Industrial Chemistry, Commonwealth Scientific and Industrial Research Organisation, Melbourne

THE development of the wax-sheet technique of Ellis[1] for the preparation of wool roots in quantity would seem to offer promising material for the study of the mechanism of protein synthesis. Some preliminary observations we have made with this object in view are discussed below.

The amino-acids present in aqueous or 70 per cent ethanol extracts of wool roots have been investigated using two-dimensional chromatography on filter paper. The amino-acids found in thirteen different extracts were as follows, the number of times each amino-acid occurred being given in parentheses:

glutamic acid* (13), glycine* (13), alanine* (13), valine* (10), leucines* (10), basic amino-acids (12), serine* (9), glutamine (9), taurine ? (6), aspartic acid (4), cysteic acid (1). The amino-acids marked with an asterisk in this list have also been identified by chromatography of their dinitrophenol derivatives on buffered silica columns, so that their identity would seem to be beyond dispute. The leucine spot has been shown to be a mixture of leucine and *iso*-leucine in the one instance in which it has been further investigated. The identity of the glutamine spot similarly rests on one complete identification. β-Alanine and citrulline occupy the same position as glutamine in a collidine–phenol chromatogram, but both these amino-acids were excluded by the fact that, on washing off and hydrolysis of material from the spot, only glutamic acid was formed, and deamination prior to hydrolysis completely destroyed reactivity towards ninhydrin. Serious doubt of identity is attached only to the taurine, which has not been further investigated and could conceivably be a peptide with similar R_f values in collidine and phenol. The basic amino-acids have not usually been conclusively identified, but on the only occasion when this was attempted both lysine and arginine were shown to be present. On one or two occasions, spots having R_f values close to those of ornithine and Dent's[2] "fast arginine" have been observed.

A further spot corresponding closely in position to α-amino-butyric acid was found on two occasions: this could conceivably be a biological precursor of proline, which is notably absent from all extracts so far examined. It is perhaps somewhat surprising that extracts from different samples of wool roots do not always yield the same amino-acids. The most probable reason for this would seem to be the necessity of balancing a fluctuating supply of amino-acids reaching the wool root against a steady demand. The alternative explanation that these are unwanted by-products would seem to be unlikely in view of the fact that all the amino-acids detected, with the exceptions of taurine and cysteic acid, are major components of wool keratin. It is also noteworthy that similar variability exists in the carboxylic acids present in wool-root extract. Although cystine is a difficult amino-acid to detect by paper chromatography, its apparent absence from all extracts examined is surprising in view of the high cystine content of the keratins. Oxidation of wool-root extract with bromine prior to chromatography in order to oxidize cystine to the more readily detectable cysteic acid has revealed the presence of very small amounts.

It is difficult to determine the sulphur content of wool roots alone, since the preparation is accompanied by an unknown percentage of fully formed fibre. One sample analysed had 2·32 per cent sulphur, which is somewhat lower than that of whole wool; hence it seems probable that wool roots are not so rich in sulphur as the final keratin. Similar observations have been made histochemically in skin[3]. A considerable fraction of the sulphur in wool roots is in the sulphydryl form: it is well known that keratinization of the fibre is accompanied by oxidation of sulphydryl groups to disulphide bonds[4]. Thus, in the previously mentioned sample, 0·71 per cent sulphur was present as sulphydryl groups and 1·55 per cent sulphur as disulphide sulphur. It is of considerable interest that 20 per cent of the sulphydryl groups were present in a masked form, and it was necessary to uncover them by denaturation with urea before they would react with ferricyanide. Approximately 67 per cent of the total sulphydryl sulphur is not extractable by water, some 29 per cent is soluble but not dialysable, and only 3·5–4 per cent is water-soluble and dialysable. It is apparent, therefore, that the major fraction of the sulphydryl sulphur is present as peptides of high molecular weight or as protein.

Lugg and Overell's[5] extension of the technique of paper chromatography to organic acids has permitted the investigation of the occurrence of those metabolites in wool-root tissue. In this way it has been demonstrated that acids of the Krebs carboxylic acid cycle occur in wool roots, although it has never been possible to detect all the acids in one extract. Thus, for example, citric, α-ketoglutaric, succinic and malic acids have been detected in one wool-root extract and succinic and fumaric acids in another.

Copper Content of Wool Roots and Shafts
(parts per million of dry tissue)

Skin No.	Roots	Shafts	Ratio roots/shafts
1	44·5	7·0	6·3
2	8·5	4·0	2·1
3	13·0	4·0	3·3
4	48·4	4·6	10·5
5	60·2	7·1	8·1
6	25·0	5·1	4·9
7	62·0	7·2	8·6

The finding by Marston[6] that copper is of great importance in the process of keratinization of wool has prompted an investigation of the copper content of wool roots and fibre. We are indebted to Mr. A. T. Dick for the analyses given in the table, which show that the copper concentration is considerably higher in wool roots than in the fully formed fibre on the same skeepskin. The results suggest the existence of some means whereby copper is withdrawn from the root as it is transformed into wool fibre.

Fig. 1. Alkaline phosphatase in wool roots

Fig. 2. Acid phosphatase in wool roots

A large number of enzyme systems have also been detected in wool-root extracts. An alkaline phosphatase has been shown by Gomori's histochemical technique[7] to be concentrated mainly in the root sheath, with smaller amounts in the root cells, but very slightly if at all in the papilla. There is some evidence that the phosphatase in the root sheath may occur in highest concentration near the zone of keratinization. Fig. 1, which is a photomicrograph of a skin section stained in this way, illustrates most of these points. Standard biochemical methods have been used for confirming the occurrence of this enzyme and also an acid phosphatase with an optimum *p*H of 4·5–5·0 which can be best extracted after sonic disintegration of wool roots in distilled water. This acid phosphatase does not require metal activation even after prolonged dialysis in distilled water, and is unaffected by 8-hydroxyquinoline or sodium fluoride. It hydrolyses a wide variety of substrates, such as α- and β-glycerophosphate (the latter preferentially), adenylic acid, fructose 1,6-diphosphate, glucose-1-phosphate and disodium phenyl phosphate. By applying Gomori's histochemical technique for acid phosphatase to skeepskin sections, this enzyme has been shown to occur in the shaft of the root in the vicinity of the zone of keratinization, but not to extend into the bulb or into the fully keratinized fibre. In sharp contrast with the alkaline phosphatase, no acid phosphatase was detected in the wool-root sheath; but it appeared to be mainly concentrated between the cortical cells, giving a striated appearance to the root shaft (Fig. 2).

Pyrophosphatase, an enzyme catalysing the conversion of sodium pyrophosphate to orthophosphate, is also readily detected in wool-root extracts. It is a typical metal-activated sulphydryl enzyme, being completely inactivated by *p*-chlormercuric benzoate and *o*-iodoso-benzoate at 0·001 *M* concentration, and fluoride, citrate and 8-hydroxyquinoline at 0·1 *M* concentration. Atmospheric oxygen causes some inactivation which can be partially reversed by cysteine. On the other hand, it is activated by 0·01 *M* magnesium salts and partially by cobalt and nickel salts. The optimum *p*H of the enzyme lies between 6 and 7.

A very similar, if not identical, enzyme also present in wool roots catalyses the hydrolysis of adenosine pyrophosphate. This enzyme appeared to differ from the inorganic pyrophosphatase in not requiring metal activation; but the occurrence of calcium as an impurity in the adenosine pyrophosphate substrate used may have already activated the enzyme. An enzyme of lesser activity and capable of converting polymeric sodium metaphosphate to orthophosphate most rapidly at *p*H 7 has also been detected in root extracts, using the method of Ingelman and Malmgren[8]. This enzyme, too, was activated by magnesium ions. Wool-root extracts also depolymerize native thymonucleic acid, and the phosphomonoesterase completes the breakdown by splitting off inorganic phosphate. No enzyme capable of liberating phosphate from lecithin or phytin could be detected. On the other hand, phosphorylase activity is demonstrable in wool-root extracts by the conversion of glucose-1-phosphate to glycogen with the liberation of inorganic phosphate. The reaction is best carried out at *p*H 6 in molar citrate buffer. Control experiments showed that at this *p*H and salt concentration the phosphatase activity of the preparation used was slight.

By use of the Thunberg tube technique, it was shown that wool roots contain an active dehydrogenase system which, however, is only partially extractable with water. The substrate for the system occurs in the wool roots and has not yet been identified. A fraction of the system can be removed by dialysis: this is heat stable and may be substrate alone or substrate and coenzyme. The enzyme is inactivated by 0·001 *M* solutions of the —SH inhibitors *o*-iodosobenzoic acid and *p*-chloromercuribenzoate, but is unaffected by 8-hydroxyquinoline. Of a wide range of organic acids tested, the enzyme is inhibited completely only by malate at 0·0067 *M* concentration and partly by succinate at the same concentration. Wool roots, from which the substrate had been partially removed by washing, dehydrogenated the following L-amino-acids: histidine, tryptophane, glutamic acid and glycine. L-Lysine, L-arginine and DL-*iso*-leucine may have been slowly oxidized, but L-proline caused a slight but definite inhibition of the enzyme. Other amino-acids which were unaffected by the enzyme system were DL-phenylalanine, DL-leucine, DL-hydroxyproline, DL-aspartic acid, DL-serine, DL-valine and DL-alanine.

Using the technique of Bertho and Grassmann[10], it was shown that wool roots contain a highly active catalase which can be extracted either by normal saline or sonic disintegration in water. The enzyme was relatively unaffected by cyanide and sulphide; but this is probably attributable to the large amounts of keratinous material present.

Wool roots also contain an esterase which can hydrolyse such simple esters as methyl butyrate and ethyl acetate at an optimum *p*H of about 7·5. Higher esters and fats and lipoids are not, however, hydrolysed even in the presence of emulsifying agents.

The frequent occurrence of taurine in wool-root extract suggested the possibility of the occurrence of cystine decarboxylase, and an attempt was made to demonstrate its presence by incubating wool roots in Warburg manometers with cysteic acid in bicarbonate buffer and a carbon dioxide atmosphere. Instead of the expected evolution of carbon dioxide, a rapid uptake was observed both in the presence of cysteic acid and in the control without cysteic acid. As no absorption of carbon dioxide was found in the presence of heated wool roots, it appears that the uptake is enzymatic in nature. No further investigation of this has been made; but it may conceivably be connected with the formation of oxalacetic acid from pyruvic acid.

The mechanism by which the sulphydryl groups of the pre-keratin are oxidized to disulphide bonds is not known, although it has been shown that gross copper deficiency of the sheep delays keratinization of the fibre, and sulphydryl groups can be detected much higher up the shafts of fibres from such deficient animals than in fibres from normal sheep[7]. Possibly the action is brought about by atmospheric oxygen and is catalysed by traces of copper, as is known to occur with cysteine *in vitro*; nevertheless, it seemed worth while to test for the presence of a 'cysteine oxidase'. Samples of wool roots were incubated with cysteine, and the disappearance of thiol groups compared with a control mixture containing heated wool roots, but no significant difference was found. A search for tyrosinase in wool roots was also unsuccessful.

The foregoing results are only of a preliminary nature, and it would be rash at present to draw any

far-reaching conclusion from them. Nevertheless, a number of interesting points arise even at the present stage. Thus the present findings lend support to the current view that the tricarboxylic acid cycle is associated with protein synthesis. The tricarboxylic acid cycle and transamination reactions can readily account for the presence of glutamic acid and alanine, two of three amino-acids found in every wool-root extract so far examined. The fixation of carbon dioxide by wool roots may well be significant from this point of view. The presence of a great variety of enzymes for the transfer of high-energy phosphate bonds is also of importance, since use is apparently made of these for supplying the energy for peptide-bond synthesis. An interesting speculation on the question of energy transfers is the possibility of utilization of the energy of oxidation of sulphydryl groups during keratinization to form more peptide bonds. Approximate calculation suggests that, in wool, the complete conversion of the whole of the sulphur from the sulphydryl to the disulphide form releases energy which could conceivably account for the synthesis of about 1 per cent of the peptide bonds in keratin. This is by no means inconsiderable and could produce aggregation of the proteins during keratinization. The E_0[11] value for cysteine–cystine[11] suggests that the formation of high-energy phosphate bonds from the system is also theoretically possible.

The dehydrogenase system present in wool roots presents a number of curious points. Thus its specificity differs from the L-amino-acid oxidase of rat kidney and liver, especially if the slight oxidation of lysine and arginine is significant. All the amino-acids oxidized by wool roots, except glycine, are optically active and belong to the L-series. The absence of activity towards other amino-acids used as DL-isomers, such as alanine and phenylalanine, suggests that D-amino-acid oxidase is absent. Catalase in the wool root may also function with the amino-acid dehydrogenase, since it is known that the L-amino-acid oxidase of snake venom produces α-keto-acid in the presence of catalase, but the reaction proceeds to the fatty acid stage in the absence of catalase[12]. Its function in the wool root may therefore be to protect keto-acids from further oxidation.

The work described in this article was carried out as part of the research programme of the Division of Industrial Chemistry, Commonwealth Scientific and Industrial Research Organisation, Australia. We should like to express our gratitude to Miss H. M. Matthews and Miss C. M. M. Mackinnon for technical assistance. Thanks are due also to Mr. W. R. Middlebrook, of the University of Leeds, for making available unpublished details of his buffered silica column procedure for the separation of dinitrophenol amino-acids.

[1] Ellis, W. J., *Nature*, **162**, 957 (1948).
[2] Dent, C. E., *Biochem. J.*, **43**, 169 (1948).
[3] Giroud, A., Bulliard, H., and Leblanc, C. P., *Bull. Histol. Tech. Micro.*, **11**, 129 (1934).
[4] Buffa, E., *J. de Physiol. et de path. gén., Paris*, **6**, 645 (1904).
[5] Lugg, G. W. H., and Overell, B. T., *Aust. J. Sci. Res.*, B, **1**, 98 (1948).
[6] Marston, H. R., "Fibrous Proteins", 207 (Society of Dyers and Colourists, Bradford, 1946).
[7] Gomori, G., *Amer. J. Clin. Path.*, **16**, 247 (1946).
[8] Ingelman, B., and Malmgren, H., *Acta Chem. Scand.*, **1**, 422 (1948).
[9] Bertho, A., and Grassmann, W., "Laboratory Methods of Biochemistry", 206 (Macmillan and Co., Ltd., London, 1938).
[10] Rykian, L. R., and Schmidt, C. L. A., *Univ. California Pub. Physiol.*, **8**, 257 (1944).
[11] Zeller, E. A., and Maritz, A., *Helv. Chim. Acta*, **27**, 1888 (1944).

OBITUARIES

Prof. Stefan Meyer

THE science of radioactivity is more than fifty years old and the number of scientific workers who can claim a share in its early development is by now exceedingly small. One of the best known died on December 29. He was Stefan Meyer, for many years director of the Vienna Radium Institute and the author of a fundamental treatise on radioactivity.

Meyer was born in Vienna in 1872 and educated in the flourishing school of atomistic physics there; for some time he was assistant in Boltzmann's institute. The decisive events for his scientific development were, however, the discoveries of Henri Becquerel and Pierre and Marie Curie in Paris. It was only one year after the discovery of radium that he began to experiment on the magnetic deflexion of its rays, in collaboration with his life-long friend E. v. Schweidler. From those days right to the end of his life his interest in radioactivity never flagged, and his influence was widely felt, not only through his own researches but also thanks to his unceasing efforts to foster international collaboration in this field. At the beginning, Austria was the only country possessing the raw material for radium production; when the Curies asked for it, the Austrian Government sent several wagon-loads to the French workers at a nominal price; and when later Ramsay and Rutherford needed "large" quantities of radium salts, these were lent to either by the Vienna Academy of Sciences for indefinite periods. In these decisions, Meyer was always consulted as one of the very few experts in this new field.

Meyer's organising ability was given full scope when in 1910 the Vienna Academy received from a private donor the means for the erection and equipment of an institute devoted to the study of radium. Although for some years the chief position was nominally held by a senior member of the Academy, it was Meyer who made the plans and, from the start, was the acting director. He took the same interest in the chemical as in the physical side of radioactivity; to mention only one example, the late Otto Hönigschmid was given facilities in the Vienna Radium Institute for his famous atomic weight determinations of radium, uranium, thorium, ionium, and uranium and thorium lead.

It is impossible to give here details of the many papers on radioactivity Meyer himself has published. Almost in every year the *Mitteilungen aus dem Institut für Radiumforschung* contained one or two of them; but even that does not give the full impression of his activities, because many of the papers by younger scientists were suggested by him and carried out under his eyes, without his name appearing anywhere. He was always happy if he could add a new number to the *Mitteilungen*; he was a mild, in a few cases perhaps too mild, critic of the contributions of the younger generation; but a glance over the titles and authors of the four hundred and fifty-odd *Mitteilungen* published up to now will reveal at once how much fundamental progress in the physics and chemistry of radioactive substances is due to research work carried out in Meyer's Institute.

So long as it was humanly possible, Meyer tried to be informed about everything that was published in radioactivity. Impressive witness to his success in this line are the two editions of the "Radioaktivität" he published, together with Schweidler, in 1916 and 1927; neither in the French nor in the English

literature was there a manual available containing such a wealth of detailed, carefully documented information.

From the institution of the International Radium Standard Committee Meyer was a very active member, and in 1938, after the death of its president, Lord Rutherford, he became his successor. The Second World War paralysed the activities of the Committee; but when three years ago efforts were made again to agree on international regulations for the standardization of radioactive sources, Meyer took a lively interest in them. Letters he wrote to colleagues up to a few days before his death were full of valuable information about previous international negotiations, and wise counsel as to how to overcome the present difficulties.

Meyer's activities as director of the Vienna Radium Institute came to an abrupt end in 1938 when the Nazis seized power in Austria; being of Jewish descent, he was dismissed. He did not leave the country but retired to his house in Upper Austria where he was fortunate enough to live unmolested, thanks to the loyalty of friends and to the courage and devotion of his daughter, who had become a Norwegian by marriage. Several brochures which have since appeared, about the theory of vision and about musical instruments, and a few theoretical contributions to the *Mitteilungen* (written jointly with his daughter), show that even in retirement his mind was constantly active.

All those who at any time have worked in Meyer's Institute, as his assistants or as guests, remember with deep gratitude his never-failing kindness. It was perhaps the most outstanding feature of his personality; but I refrain from enlarging on it as tribute will be paid to Meyer's friendliness by one who came to know him well in specially difficult circumstances.

F. A. Paneth

I first met Prof. Meyer nearly thirty-seven years ago, when I began work in his Institute. The First World War extended my sojourn in Vienna to nearly six years, and a firm and enduring friendship developed between us. As the only Englishman who has worked in his laboratories, it is perhaps fitting to recall a few personal experiences, for there could be no better revelation of his personal charm and good nature, his warm friendship and his innate kindliness.

Twice in the early months of the War, I was taken into police custody as an 'enemy alien'. On the first occasion Prof. Meyer was at his country home in Bad Ischl, and although I had known him for only a year, he travelled to Vienna as soon as he heard the news, applied for my release, and on the third day he and his 'first assistant', Prof. V. F. Hess, called for me at the Central Police Station and took me home by taxi. On the second occasion he achieved my release on the second day; after that all went well, except that I had no funds and could not for many months communicate directly with my parents. But rather than that I should stagnate in an internment camp, Meyer again intervened. For the rest of the War he supplied me with money on trust and free of interest, the amounts being left to my discretion, and he established intermittent but adequate contact with my parents through the good offices of that great-hearted and kindly man of science, Prof. H. Kamerlingh Onnes, who devoted much time to work of this kind for others similarly placed to myself.

On all festive occasions throughout the War I never failed to find good things on my work bench from Meyer and his colleagues; at Christmas time *Krampus* was always there, at Easter the 'Easter hare', and on birthdays an iced cake resplendent with candles and good wishes. Scientific visitors from abroad could always be assured of friendly discussion and a hearty welcome to the Institute, and I recall how Meyer used to look forward to vacation visits of his old friend Dr. Lise Meitner, a native of Vienna. I remember, too, a visit from Prof. Nernst, and how, with a merry twinkle in his eyes, Meyer said to him: "But before you go you must meet our English prisoner!"

This account would be incomplete without mention of his happy home life with Mrs. Meyer and their son and daughter, all of whom survive; it was one of the high-lights of life in the Institute to be entertained by these charming personalities. In the truest sense, Meyer was an ardent patriot of the old Austria-Hungary, and in no wise a hide-bound nationalist. Science to him was international, and he acted accordingly. In his personal relationships he was always sincere; when the situation required it he could be firm, but never unkind. I salute the memory of an outstanding man of science, a true Austrian, and a staunch friend.

Robert W. Lawson

Prof. Battiscombe Gunn, F.B.A.

Battiscombe George Gunn, fellow of the Queen's College, Oxford, and professor of Egyptology in the University, died after a long illness on February 27.

Gunn was the son of a London stockbroker and was born in 1883. His father destined him for a business career, and after the completion of his education at Westminster School and Bedale's, he entered the service of a City bank; but although brilliant at figures and entirely competent at his work, he found it so distasteful to his temperament that it was soon abandoned; a second project, that of becoming an engineer, in which his mathematical gifts would have served him well, was likewise dropped. Gunn's tastes led him into the field of literature and philology, and he early began the study, self-taught, of the language and writing of ancient Egypt. In 1906 he produced a small book, "The Instruction of Ptah-hotep", in which he attempted the translation of one of the oldest and most difficult of literary texts, the Prisse Papyrus in the Bibliothèque Nationale of Paris, a production which, although premature, displays a grasp of the intricacies of the language and a latent talent that was destined to be brilliantly developed later. Gunn had not yet adopted Egyptology as a career, however, and during 1908–11 he was private secretary to Sir Arthur Pinero and afterwards a sub-editor of the Paris *Daily Mail*.

An opportunity in keeping with his tastes arose when in 1913 he went as assistant to Petrie, who was then excavating in Upper Egypt; and his special work was copying the texts discovered and preparing them for publication. In 1914 he joined the Armed Forces; he was eventually invalided out of the Army, and became for some years assistant to Sir Alan Gardiner. It was then that his brilliant powers found full scope. Sir Alan has himself acknowledged the mutual benefit that arose from this association. In 1924, Gunn published his "Studies in Egyptian Syntax", a work of fundamental importance in philology.

In 1921, Gunn returned to Egypt and took part in the excavations at Amarna, and was afterwards appointed to a post in the Service des Antiquités of the Egyptian Government, when he carried out excavations in the pyramid-field at Sakkara and was an assistant conservator of the Cairo Museum. Thence he passed to Philadelphia, where he was curator of the Egyptian Department of the Museum (1931–34). The death of Prof. Peet in 1934 rendered the Oxford chair of Egyptology vacant and Gunn was appointed his successor. It was here that he found scope for imparting his vast knowledge to others. This privilege was not only reserved for his own pupils but was freely at the service of his colleagues and friends, especially of young students at the outset of their careers. Gunn never forgot that he was once a beginner himself, and he took infinite pains to give of his best to all who applied to him for help; indeed, his letters, of which I have many and have seen many more, are veritable monographs of their respective subjects.

Gunn's published output, in terms of mere numbers, is not large. There are two reasons for this: first, he set himself so high a standard that he never printed any merely interim or provisional work, but always delayed it until he was satisfied that it contained the best he was capable of putting into it; and secondly, he devoted so much of his time to the service of others that he deprived himself of the benefit of many of his working hours.

Gunn received the honorary degree of M.A. of Oxford, the fellowship of the Queen's College, and was elected in 1934 to the British Academy.

W. R. Dawson

Prof. W. P. Wynne, F.R.S.

William Palmer Wynne died on February 16 at Urmiston, near Manchester, in his ninetieth year. The eldest son of a boot manufacturer, Wynne grew up under strict Victorian discipline. At King Edward School, Birmingham, he developed a special interest in chemistry. He was eventually apprenticed to a firm of manufacturing pharmacists, and worked at evening classes, so gaining a free studentship to the Royal College of Science, London, where he graduated with distinction.

In 1886 he became private research assistant to Prof. H. E. Armstrong at the Central Technical College, South Kensington, London, and in 1889 was appointed lecturer. Two years later he succeeded F. R. Japp as assistant professor at the Royal College of Science, serving successively under Profs. T. E. Thorpe and W. Tilden, but still collaborating with Armstrong in his research work.

After two years as professor to the Pharmaceutical Society, Wynne was appointed in 1904 to the Firth chair of chemistry in the University College of Sheffield, which was granted its charter as a full university in the following year. From this time onwards he was increasingly occupied with administrative duties. He was dean of the Faculty of Science continuously during 1911–31 and a member of the Finance Committee of the University for most of that time. Wynne took a leading part in the development of the University; he was particularly interested in student affairs and was largely responsible for the provision of adequate playing fields and their proper equipment. The Chemistry Department flourished under Wynne; but his official duties left him little time for research work. He retired in 1931, at the age of seventy, as emeritus professor, and moved to Cambridge, where his old friend, Sir William Pope, provided him with a laboratory. During the next fifteen years he was able to return to his earlier work on naphthalene and to extend it.

Wynne took his full share in the work of scientific societies, having served as honorary secretary, editor and president (1923–25) of the Chemical Society, and presided over Section B of the British Association at Birmingham in 1913. He was elected to the Royal Society in 1896. During 1938–43 he was a member of the University Grants Committee. He was also a representative of the Sheffield diocese in the National Assembly of the Church of England. He was twice married and had three children, of whom one, a daughter, survives him.

The work which Wynne carried out with Armstrong during the years 1886–97 was of classical importance in developing the chemistry of naphthalene. Its object was to discover the laws of substitution in naphthalene and to provide sure means of determining the orientation of the many substituted naphthalenes that were being discovered. To this end, they first established the existence and the identity of each of the ten possible dichloronaphthalenes. Most of these had already been described by Cleve and other European workers, but Wynne's experiments showed that two of these were non-existent. The sulphonation products of all the dichloronaphthalenes were studied. Displacement of the sulphonyl chloride group gave in each case a trichloronaphthalene, and in this way eight of the fourteen possible trichloronaphthalenes were also identified. Further work led to the isolation and orientation of the remaining six isomerides. The thoroughness with which this work was checked is shown by the fact that, in all, fifty-three independent synthetical preparations were made yielding one or other of the fourteen isomerides.

During these eleven years Armstrong and Wynne made forty-one communications to the Chemical Society on naphthalene chemistry, and much new light was thrown on the naphthylaminedisulphonic acids, the structure of several important members of this group being demonstrated. The collaboration was unfortunately interrupted at the end of 1897, and various circumstances delayed the completion of the work. It is regrettable that the authors did not at that time give full experimental details of their work, which appeared only as short papers in the *Proceedings of the Chemical Society*. The responsibility for this, however, undoubtedly rested on the senior worker, Armstrong.

In 1941, in collaboration with Miss E. G. Turner, Wynne published a further important paper, describing the products of sulphonating all the trichloronaphthalenes, in which the production of fifteen of the twenty-two possible tetrachloronaphthalenes was also recorded, in seven of which the orientation was proved, and in each of the others the position of three of the chlorine atoms was certain. Two years later he described a new tetranitronaphthalene. He also published a series of investigations of the sulphonic acids of the chlorotoluenes.

Wynne's work on naphthalene was monumental, and it is fitting that a beautiful collection of some 465 of his specimens should now be preserved in the Research Department of the Dyestuffs Division of Imperial Chemical Industries, Ltd.

G. M. Bennett

NEWS and VIEWS

Maritime Regional Laboratory, Halifax, Nova Scotia: Prof. E. G. Young

PROF. E. GORDON YOUNG, since 1924 professor of biochemistry in Dalhousie University, has been appointed director of the National Research Council's Maritime Regional Laboratory at Halifax, Nova Scotia. This new Laboratory, now under construction on the campus of Dalhousie University, will be a centre for research on scientific and industrial problems of direct interest to the Maritime Provinces and will co-operate with the scientific departments of the universities in the Maritime Provinces and Newfoundland. Born in the city of Quebec, where he received his early schooling, Prof. Young went to McGill University, graduated with honours in chemistry in 1916 and took his M.Sc. in 1919. From McGill he went to the University of Cambridge as a Ramsay Memorial Fellow to study biochemistry under the late Sir Frederick Gowland Hopkins, and in 1921 he received his Ph.D. Returning to Canada, he was appointed professor of biochemistry at the University of Western Ontario, where he remained until 1924 when he took up his present post at Dalhousie University. During 1942–46 Prof. Young was attached to the Department of National Defense in the chemical warfare service. He has published a number of papers on purine metabolism, chemistry of proteins, metabolism of bacteria and general nutrition subjects.

Scottish Marine Biological Association

ON April 1, 1950, important alterations were made in the organisation of the Scottish Marine Biological Association, and new responsibilities were assumed. The registered offices of the Association were transferred from 185 St. Vincent Street, Glasgow, to the Marine Station, Millport, Isle of Cumbrae. The long and valued service given by Mr. A. Lawrie Brown as secretary and treasurer ended when the former office was assumed by the director, Mr. E. Ford, while Dr. J. H. Paul, of Millport, became honorary treasurer. At the same time the Association extended its activities to the east of Scotland by taking over, from University College, Hull, control of the Oceanographical Laboratory at Leith, Edinburgh. This Laboratory represents the final outcome of the plankton recorder work established at Hull by Prof. A. C. Hardy, and afterwards under the charge of Dr. C. E. Lucas, now director of fishery research, Scottish Home Department. For some years past the work has been increasingly concentrated at Leith, and it has now been entirely transferred there. The council of the Association will be advised on all matters concerning the scientific policy of the Leith Laboratory by a committee which will include Prof. A. C. Hardy and also representatives from the Scottish and English fishery services and from the Marine Biological Association of the United Kingdom. Mr. K. M. Rae continues in charge of the Laboratory.

The facilities of the laboratory at Millport are being improved by the erection of a large concrete tank, designed initially for experiments on oyster breeding. Danger of collapse of a portion of the laboratory buildings has necessitated some rebuilding which will at the same time make good loss of research space due to the need for housing an increased administrative staff. At the last annual general meeting of the Association the resignation from the office of president of Sir John Graham Kerr was received with very great regret. He has been succeeded by Prof. C. M. Yonge (also chairman of council), while Prof. J. Ritchie becomes vice-president.

William Henry Welch (1850–1934)

BORN a century ago, on April 8, 1850, William Henry Welch was one of the most versatile men of his age. After taking his arts degree at Yale University and his medical degree at Columbia University, he studied in Germany under Waldeyer, Ludwig, Cohnheim and Koch. In 1878 he established at Bellevue Hospital, New York, the first pathological laboratory in America, and six years later was appointed professor of pathology at Johns Hopkins University. Known as the 'Dean of American Pathology', he did pioneer work on acute œdema of the lungs, on venous thrombosis in heart disease and on diphtheria antitoxin, separated the white skin staphylococcus, and discovered the *Bacillus aerogenes capsulatus*, which bears his name. In 1900 he transferred his energies and enthusiasms to medical education and to public health. He helped to organise the Rockefeller Institute for Medical Research, serving as chairman of its board of scientific directors until his death, and for many years he was dean of the Johns Hopkins Medical School. In 1918 he became director of the newly founded School of Hygiene and Public Health at Baltimore, exchanging this post in 1926 for the chair of history of medicine. Three years later he created an Institute of the History of Medicine and became its first director. He died on April 30, 1934. A small, rotund, bald-headed man with a vandyke beard and a mischievous twinkle, Welch—affectionately known as 'Popsy'—was a confirmed bachelor who lived in two rooms crowded with books. He possessed an uncanny memory, and appeared to know the answer to everything without ever seeming to work.

Thirty Years of Rubber Research

IN commemoration of the thirtieth anniversary of its foundation, the Research Association of British Rubber Manufacturers has issued a booklet entitled "Thirty Years of Rubber Research, 1919–1949" (pp. 28; from 105 Lansdowne Road, Croydon, Surrey), in which the growth and development of the Association are described, and its past and present activities reviewed. The functions of the Association cover original scientific investigations, intelligence and information services, and technical advice to the industry. Its scientific work has included diverse studies of the physical and chemical properties of rubber. While the emphasis in these has been mainly on standardization and systematization, a number of problems of wide scientific interest have been attacked, such as, for example, plastic flow in raw rubber, crack formation in the ageing of vulcanized rubber, and the mechanism of carbon-black reinforcement. The technical laboratory service, operated by a special staff, is designed to meet the needs of the manufacturer for assistance and advice, and, if necessary, for further research, in connexion with his own special problems. The library and information services include the comprehensive collection and dissemination of technical articles and abstracts relating to rubber, both by way of special publications and in response to individual requests. Judging by the figures quoted, this service is fully utilized and much appreciated, not only by regular subscribers but also by all those who may be in any way concerned with rubber.

Israel Institute of Applied Social Research

With the expansion of its work to other fields of a sociological and sociopsychological nature, the Israel Institute of Public Opinion Research, which was formed last year (see *Nature*, August 6, 1949, p. 214), has been reorganised into the Israel Institute of Applied Social Research. Besides current nation-wide opinion polls, the Institute is now engaged in a study of adjustment problems among new immigrants. Another extensive and intensive study on problems, plans and attitudes of the youth of Israel is in preparation. Among other subjects which the Institute has been commissioned to analyse are: the experience of dwellers in the new housing projects, radio listening and juvenile delinquency. Projects are accepted from the various government departments and from other civic bodies, as well as market research for private firms and organisations. Basic social research and experiments in survey techniques will be important features of the theoretical work of the Institute. It also co-operates in joint projects with scientific organisations in other countries. The first issue of the quarterly bulletin, *What Israel Thinks* (price, 2 dollars a year), has appeared. Published in English, the bulletin is designed to give summaries for the non-Hebrew reader of the reports of the Institute on its continuing opinion surveys, as well as news about social research in Israel. The more comprehensive sociological and psychological studies of the Institute will be published separately in monograph form in Hebrew (price, 15 dollars a year) and in English. Dr. Louis Guttman and Dr. Uriel G. Foa continue as scientific director and executive director, respectively, of the Institute. The new address is Israel Institute of Applied Social Research, Sergei Building, Melisande Way, Jerusalem, Israel.

Australian Journal of Agricultural Research

A new quarterly periodical, the *Australian Journal of Agricultural Research* (pp. 102; Melbourne: Secretary, C.S.I.R.O., 314 Albert Street, East Melbourne, C.2, Australia; 30*s*. a year), under the editorship of Dr. N. S. Noble, is being issued by the Commonwealth Scientific and Industrial Research Organisation in collaboration with the Australian Institute of Agricultural Science and the Australian Veterinary Association. The *Journal* is intended as a medium for the publication of the results of original investigations on problems concerned with soils, plants and domestic animals, and will deal with the physical, chemical and biological aspects of these fields of research. The first number appeared in January 1950 and contains papers covering a wide range of subjects. These include problems connected with potato virus diseases and seedling blight of peas, the action of growth substances on various plant species, sheep mating and lambing, and locust control, as well as studies on trace-element contents of herbage in relation to animal health. In addition, techniques are described for use in nematode investigations in sheep and cattle.

L'Illustrazione Scientifica

A new monthly scientific review, *L'Illustrazione Scientifica* (Milan: Aldo Garzanti; 2,200 lire a year), has as its object the dissemination of those advances made in scientific laboratories throughout the world, both during and since the Second World War, which "influence our daily life more and more for better or worse". It is the intention of the editor-director, R. de Benedetti, to publish articles by experts in their respective branches of science, written in a style which will give them humanistic rather than technological appeal—and, as the name indicates, to have them illustrated by plenty of photographs. Indeed, the publisher is so anxious for the cultural and literary reputation of his firm that he promises that all technical minutiæ will be avoided in the expositions. (How many popular scientific journals have started with this pious hope!) The number under review ably carries out these intentions with five articles covering between them a wide field: animal life in the desert, X-ray microscopy, acoustics of the classical theatre, antibiotics and stitches for wounds. Two of these are translations of articles which have already appeared in English in another journal. In wishing success to this new venture, we may perhaps be permitted to express the hope that it may soon have at its disposal sufficient original articles to be able to subsist without such reproductions, admirable as the articles so chosen may be.

Wool Education Society

The International Wool Secretariat, a non-profit-making body set up by the statutory Wool Boards of Australia, New Zealand and South Africa to further the uses and usefulness of wool, has recently set up, through its Department of Education, a new organisation to be known as the Wool Education Society. The main object of this Society is to disseminate knowledge of all types relating to wool, particularly new developments in the field of wool technology, and membership is open to teachers, educationists and others interested in wool textiles. At first, meetings will be held in London; but these will be extended to the provinces when possible, and full reports of lectures will be circulated to members. The annual subscription of 7*s*. 6*d*. covers the receipt of the Secretariat's quarterly educational journal, *Wool Knowledge*. All inquiries should be addressed to P. A. Wells, Director of Education, International Wool Secretariat, Dorland House, 18–20 Regent Street, London, S.W.1.

Ergonomics Research Society

In July 1949 a group of people decided to form a new society for which the name "The Ergonomics Research Society" has now been adopted. Ergonomics is by definition to mean "the study of the relation between man and his working environment", particularly the application of anatomical, physiological and psychological knowledge to the problems arising therefrom. This covers the field which has variously been described as 'fitting the machine to the man', human engineering, that part of industrial psychology not concerned with vocational guidance, etc. The rules of the Society provide that ordinary members shall be research workers in the fields mentioned and that others interested may become associate members. It is hoped to hold meetings three or four times a year at which papers will be read and demonstrations given, and to publish papers presented to the Society. Further particulars can be obtained from the Secretaries, Ergonomics Research Society, Sussex House, 34 Palace Road, East Molesey, Surrey.

Forest Department of Jamaica: Annual Report

In the annual report of the Forest Department of Jamaica for the year ending March 31, 1948 (pp. 8.

Kingston: Forest Department, 1949), Mr. E. W. March, the conservator, states that the afforestation financed by the Colonial Development and Welfare Funds continued to be the main object of the Department during the year. At the same time, the wider outlook and activity of a forest department are now being gradually adopted. The general forest policy for Jamaica is outlined and shows that the outlook of the Government itself is wider than in the past. Three points are laid down: (1) the establishment of adequate areas of forest reserves under public ownership and their management on the basis of conservation and development for multiple use (protective, productive, scenic, recreational and wild-life); (2) the encouragement of sound forest management on private lands; (3) the development of the use of native timbers and other forest products to provide the highest possible proportion of the requirements of the Island. Under forest offences, fire is one of the chief causes; but on this subject the report is rather vague. The writer says: "The menace of bush fires caused by cultivators burning as an aid to clearing continues to be one of the main causes of soil deterioration in the Island and one of the biggest handicaps facing the soil conservationist and agriculturist". If by this, as one would suppose is the case, the conservator is alluding to shifting cultivation, it surely merits a more detailed consideration in a forestry report than these few lines.

Ellipsoidal Waves, Gravitation and Magnetism

About five years ago (*Nature*, 155, 4; 1945) an account was given of H. Varcollier's theory of ellipsoidal waves. In a recent paper (*Arch. Sci. Phys. et Nat.*, 2, Fas. 1 and 2; 1949) he develops this further into a form of unified field theory, with special emphasis on the connexion between gravitation and magnetism. It is claimed (pp. 82–88) that this theory leads directly to the Prunier–Blackett formula connecting the magnetic moment of massive rotating bodies with their angular momentum. On pp. 81–82 is suggested an experimental test of the theory which might be performed with two magnets in a laboratory.

University of Sheffield

Work is to begin shortly on a great enlargement of the buildings of the Engineering Departments of the University of Sheffield, one of the most important items in the University's development programme and one which most closely touches local industries. The new building will join on to the existing buildings at St. George's Square. It will provide completely new accommodation for the Department of Civil Engineering, will treble the space available for the Department of Mechanical Engineering and by the consequent rearrangements will make room for a much-needed expansion of the Department of Electrical Engineering. The Departments will then be able to accept each year some three times as many students as can be admitted now, there will be more adequate provision for research and the new Postgraduate School of Applied Mechanics will be worthily housed. The total cost of erection and equipment of the new Engineering building is estimated at £350,000. The University Grants Committee has made a grant to the University of £250,000 towards the cost, and the balance will have to be met from the University's Development Fund.

Scottish Branch of Aslib

A Conference of the Scottish Branch of Aslib will be held at the Mitchell Library, Glasgow, on April 14; Dr. D. G. Brown, chairman of the Branch, will preside. The opening address will be delivered by the Right Hon. Thomas Johnstone; after which there will be papers by James Fergusson, keeper of the Records of Scotland; Sir James French, chairman of the Royal Technical College, Glasgow, on "Books in Industry"; W. A. Beck, superintendent for Scotland of H.M. Stationery Office, on "The Range of Government Publications"; and S. Weinberg, Research Department, G. and J. Weir, Ltd., on "The Attitude of the Research Worker to Technical Information". Further particulars can be obtained from the Honorary Secretary, Scottish Branch of Aslib, at the Institute of Seaweed Research, Inveresk Gate, Musselburgh, Midlothian.

Announcements

The Council of the Institute of Welding has awarded the Sir William J. Larke Medal, for the best paper read to the Institute during the year, to Mr. R. G. Braithwaite, welding consultant to Braithwaite and Co. (Structural), Ltd., for a paper on the control of distortion in arc welding.

The thirty-eighth Progress Medal of the Royal Photographic Society has been awarded to Prof. John Eggert, of the Swiss Federal Institute of Technology, Zurich, in recognition of his classical work in latent image theory, particularly on the quantum efficiency carried out with Noddack; for his work on the effect of X-rays on photographic emulsion; and in evolving methods of standardization of photographic speed and graininess. The Medal, which is the highest honour the Society can bestow, is awarded annually in recognition of any invention, research, publication or exhibition which shall have resulted in any important advance in the science, art or practice of photography.

M. Caquot (France) has been elected president of the Organisation for Standardization (ISO) in succession to Mr. Howard Coonley (United States). M. Caquot has had a distinguished career as a civil engineer. Membership of the Organisation is confined to representatives of the national standards bodies throughout the world.

The London Section of the Oil and Colour Chemists' Association is organising a technical trade exhibition of raw materials and equipment used in the paint, varnish and printing-ink industries, to be held at the Borough Polytechnic, Borough Road, London, S.E.1, during April 13–14 (3–9 p.m. each day).

At the annual general meeting of the Chemical Society held in Edinburgh on March 29, the following were elected officers: *President*, Prof. E. K. Rideal; *Vice-President*, Prof. R. P. Linstead; *New Members of Council*, Dr. J. S. Anderson (Harwell), Prof. L. Hunter (Leicester), Prof. F. E. King (Nottingham), Dr. L. N. Owen (London, Imperial College).

Erratum. In the communication entitled "Oxidation of Catechol by Tea-Oxidase" (*Nature*, January 7, p. 32), the description of curve II in Fig. 1 is incorrect; the system under examination contained 40 mgm. washed enzyme + 11 mgm. catechol + 3 mgm. ascorbic acid at *p*H 5·6.

AN X-RAY MICRO-BEAM EXAMINATION OF A PLASTICALLY DEFORMED METAL

By J. N. KELLAR, P. B. HIRSCH and J. S. THORP
Crystallographic Laboratory, Cavendish Laboratory, Cambridge

THE present research was begun by the late J. N. Kellar more than three years ago, and has been continued by the other authors since his death in July 1948.

To check current theories of the strength of polycrystalline metals[1], the size and degree of deformation of the crystals constituting plastically strained metals must be known. Most of the existing information has been derived from X-ray line-broadening experiments. The broadening of the diffraction rings has been interpreted, in the main, as arising from either small particle-size[2] or the existence of a range of strains in the material[3]. The present method consists of illuminating such a small volume of material that the continuous ring obtained with the usual techniques splits up into individual diffraction spots. This is done by using fine-bore lead glass capillaries and a high-intensity X-ray generator which gives an intensity improvement (in watts per sq. mm.) of fifty times by comparison with an ordinary tube. From the number of spots and their shapes, estimates of particle-size and distortion can be obtained.

To test this method a specimen of cold-rolled spectroscopically pure aluminium was chosen, as with this material photographs can be obtained in a reasonable time. A rod of diameter 6·25 mm. was rolled down to a flat strip of thickness 2·7 mm. and etched down to 2·65 mm. A series of back-reflexion photographs of this specimen were taken with a micro-beam of diameter ~ 35 μ for a range of divergence from about 2′ to 9′. Fig. 1 shows two photographs of the (422) ring taken (*a*) with an ordinary back-reflexion camera, and (*b*) with a micro-beam of diameter ~ 35 μ.

The fact that the continuous diffraction ring can be split up into individual reflexions shows that the material contains well-defined crystalline regions ('particles'), and that the continuous ring obtained by the usual techniques is due to the superposition of the reflexions from a large number of these regions. If N_1, N_0 are the numbers of spots counted on the same ring for two different exposures T_1, T_0, it can be shown that (on certain assumptions which will be discussed in a later detailed publication),

$$\frac{N_1 - N_0}{A \log_{10}(T_1/T_0)} = \frac{2{\cdot}3\, p \cos\theta}{2\mu(1 - \sec 2\theta)} \cdot \frac{1}{v} \cdot (d\theta + \Delta),$$

where A is the area of specimen illuminated, p is the multiplicity factor, μ is the absorption coefficient, v is the mean volume of a single crystal particle, $d\theta$ is the divergence of the beam at the specimen, Δ is a term related to the probability of the spots occurring on the ring and being counted. Δ depends on the shape and distortion of the crystal particles, and on the wave-length spread of the radiation (cf. ref. 4).

Fig. 2 shows a graph of $\frac{N_1 - N_0}{A \log_{10}(T_1/T_0)}$ plotted against a linear function of the divergence, for the material examined a year after rolling. The mean particle-size t (defined as the cube root of the volume) is found to be $1{\cdot}7\,t$ ($\pm$ 10 per cent). This result may be compared with the spacing of $2\,\mu$ between slip zones in deformed spectroscopically pure aluminium examined in the electron microscope[5]. This value of t has not been corrected for preferred orientation, but preliminary experiments indicate that the effect on t is small. Further preliminary experiments indicate that the particle-size a few weeks after rolling is about $3{\cdot}6\,\mu$, and a few months afterwards is about $2{\cdot}2\,\mu$ (this last measurement was taken on a different specimen which was rolled down to the same extent). Although these results are only approximate, it appears that the particle-size of the material decreases with time after rolling.

The tangential and radial lengths of the spots were measured and averaged around the ring. To a first approximation, the tangential width S_T of the spots is

$$\frac{R_0}{|\cos 2\theta|} \cdot (d\theta + B_T), \qquad (1)$$

where R_0 is the specimen to film distance, B_T is the tangential broadening due to distortion and shape of particles.

Fig. 3 shows (circles), for the material examined a year after rolling, the experimental values of S_T/R_0, averaged around the ring, for different values of $d\theta$ (the divergence of the beam at the specimen). The straight line is drawn with the slope $\frac{1}{|\cos 2\theta|}$ given by equation (1) above, and its position is chosen to give the best fit with the experimental points. From the intercept which this line makes with the horizontal axis, B_T is found to be $\sim 7 \times 10^{-4}$ radians.

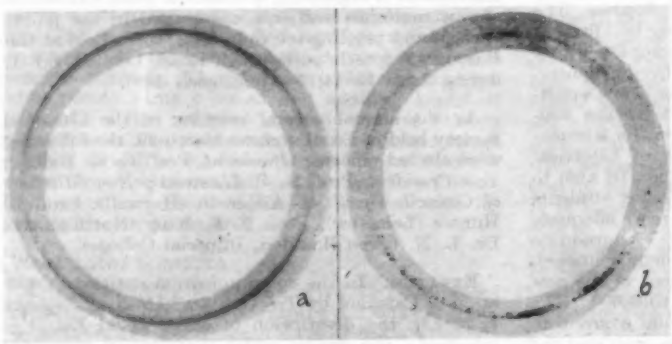

Fig. 1. Photographs of 422 ring of cold-worked aluminium. (*a*) Taken with ordinary back-reflexion camera; (*b*) taken with a micro-beam of diameter 35 μ

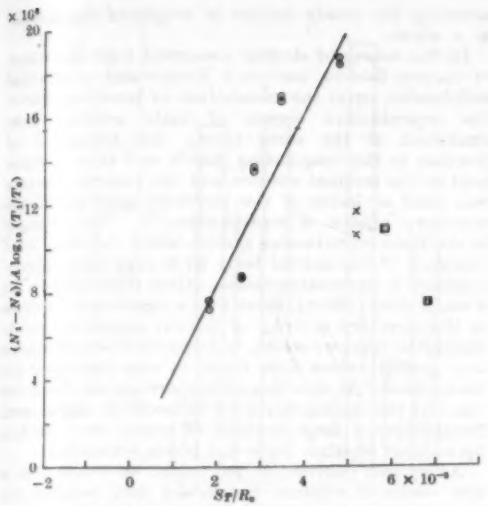

Fig. 2. $\frac{(N_1 - N_0)}{A \log_{10}(T_1/T_0)}$ against a linear function of the divergence. ○, Spectroscopically pure aluminium examined twelve months after cold-working; □, same specimen examined three weeks after cold-working; ×, new specimen, rolled down by same amount, examined four months afterwards

As the divergence is increased, the radial lengths S_R of the spots reach a constant value given approximately by

$$\frac{R_0}{\cos^2 2\theta} \cdot (d\alpha + B_R), \qquad (2)$$

where $d\alpha$ is the broadening due to wave-length spread of the emission line; B_R is the radial broadening due to distortion and shape of particle.

Fig. 4 shows the graph of S_R/R_0 plotted against $d\theta$. From the constant value of (2), B_R is found to be $\sim 1{\cdot}8 \times 10^{-3}$ radians for the material a year after rolling.

Further experimental results (also shown in Fig. 4) show that B_R decreases with time after rolling.

The physical significance of these preliminary results may be made clear, qualitatively, as follows. The experiments show that the individual spots are broadened (cf. B_T, B_R above). The shapes of the spots indicate the nature of the interference function in reciprocal space. This in turn must be interpreted in terms of the dimensions and distortion of the particle. The number of possibilities is limited, since the volume of the particles is known (cf. t above). The experimental results obtained so far tend to indicate that particle-size effects alone cannot account for the whole of the observed diffraction broadening of the individual spots, and that distortion is present.

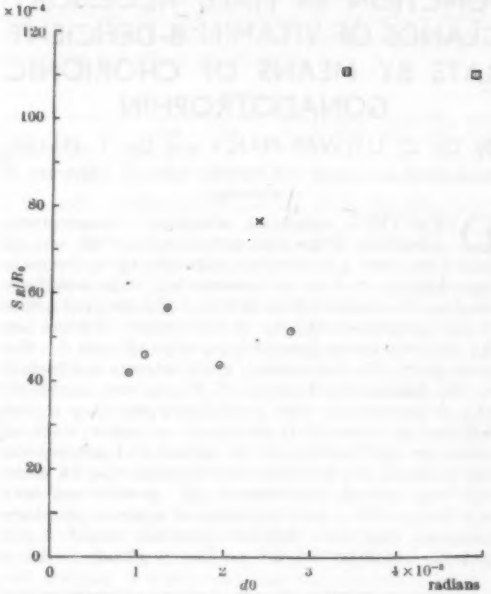

Fig. 4. S_R/R_0 against divergence of X-ray beam. ○, Spectroscopically pure aluminium examined twelve months after cold-working; □, same specimen examined three weeks after cold-working; ×, new specimen, rolled down by same amount, examined four months afterwards

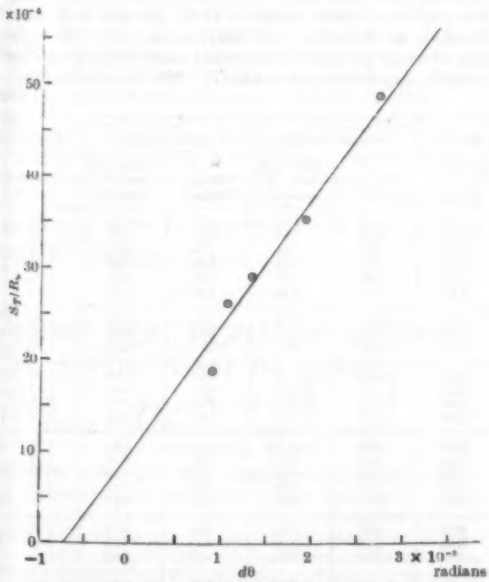

Fig. 3. S_T/R_0 against divergence of X-ray beam. ○, Spectroscopically pure aluminium examined twelve months after cold-working

Assuming that distortion-broadening is due to bending of the particles, the decrease of B_R with time may correspond to a decrease of the average bending: this, and the decrease of t with time, are compatible with the occurrence of the process of polygonization[6].

The broadening of the diffraction line observed when an ordinary back-reflexion camera is used (cf. Fig. 1, *a*) is due, at least in part, to the broadening of the individual spots produced by the 'particles'. If the particles have a resultant mean strain, differing from particle to particle, the broadening of the diffraction line as a whole may be in excess of that due to the broadening of the individual spots; at present we have no evidence on this point.

The results quoted are to be regarded as preliminary only. Further experiments and a fuller interpretation of the results are being undertaken. Details of these, of the X-ray tube and of the microbeam technique will be described elsewhere.

One of the authors (P. B. H.) wishes to acknowledge maintenance grants from the British Iron and Steel Research Association and the Department of Scientific and Industrial Research; and one (J. S. T.) wishes to thank the directors of the Metropolitan-Vickers Electrical Company, Ltd., for permission to publish this paper.

[1] Bragg, Sir Lawrence, *Camb. Phil. Soc.*, **45**, Pt. 1, 125 (1948).
[2] Wood, W. A., *Proc. Roy. Soc.*, A, **172**, 231 (1939).
[3] Stokes, A. R., Pascoe, K. J., and Lipson, H., *Nature*, **151**, 137 (1943).
[4] Stephen, R. A., and Barnes, R. J., *J. Inst. Metals*, **60**, 285 (1937).
[5] Brown, A. F., *Nature*, **163**, 961 (1949).
[6] Guinier, A., and Tennevin, J., *C.R. Acad. Sci., Paris*, **226**, 1530 (1948).

RESTORATION OF SECRETORY FUNCTION IN MALE ACCESSORY GLANDS OF VITAMIN B-DEFICIENT RATS BY MEANS OF CHORIONIC GONADOTROPHIN

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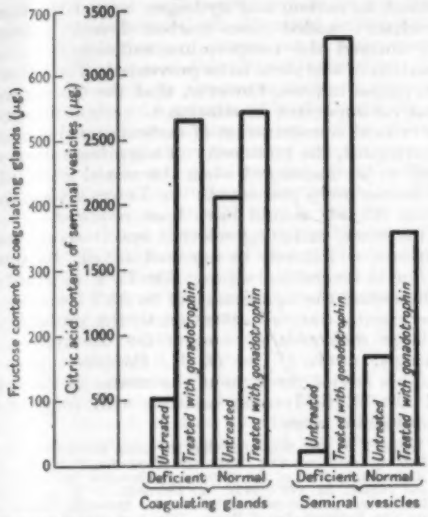
DEFECTIVE nutrition, abnormal temperature, infection, drugs and certain radiations are all known to exert a deleterious influence upon the male reproductive system in mammals; this manifests itself in the deterioration of either the spermatogenic or the endocrine activity of the testes. Seldom are the two testicular functions equally affected by the same agent. In this respect, great interest is attached to the fundamental study of Moore and Samuels[1], who demonstrated that partial starvation or a diet deficient in vitamin B produced in rats a state of endocrine dysfunction of the testes and subsequent regression of the prostate and seminal vesicles without any major impairment of spermatogenesis; injections of the testes hormone, or anterior pituitary hormone, into such deficient animals remedied the castrate condition of the accessory glands without arresting the steady decline in weight of the animal as a whole.

In the course of studies concerned with the effect of various factors, including X-rays and nutritional deficiencies, upon the metabolism of bone marrow[2,3], the reproductive organs of male animals were examined at the same time; the formation of fructose in the coagulating glands and that of citric acid in the seminal vesicles and the ventral prostate was used as index of the secretory activity of the accessory organs of reproduction[4–7]. The changes in the male reproductive system which followed total exposure of the animal body to X-rays were largely confined to spermatogenesis. After irradiation with a single dose (500 r.), there was a significant decrease in the secretory activity of the rat accessory glands during the first two weeks, but this effect was transient and normal values were found in rats examined six weeks later. At this stage the spermatozoa from the vas and the epididymis were immotile in saline, and furthermore a large number of sperm were broken up so that separate tails and heads abounded.

As regards nutritional deficiency, we found that a few weeks of vitamin B-deficient diet reduced the content of citric acid and fructose in male accessory glands to a level comparable with that of castrated rats. The secretory activity of the glands was, however, completely restored by injections of either testosterone propionate or of purified chorionic gonadotrophin. It seems correct to assume that it was not primarily a lesion involving the testicular hormone-producing tissue, but a failure in the hypophyseal mechanism which led to diminished secretory activity in the accessory organs. For the experiment recorded in the accompanying table and diagram, the rats were kept on stock diet until three months old, then for a further four weeks some were given a vitamin B-deficient diet composed of 40 parts of rice starch, 23 light white casein, 17 cane sugar, 15 arachis oil and 2·5 cod liver oil; whereas the rats serving as controls had the same diet but supplemented with 7·5 per cent dried yeast. Both groups were subdivided as follows: (i) untreated, (ii) 100 μgm. testosterone propionate injected daily during the last (fourth) experimental week, (iii) 200 units (200 μgm.)

Male rats		Body-weight		Coagulating glands		Seminal vesicles		Ventral prostate		Testes
Group	Treatment	Initial (gm.)	Final (gm.)	Weight (mgm.)	Fructose content (μgm.)	Weight (mgm.)	Citric acid content (μgm.)	Weight (mgm.)	Citric acid content (μgm.)	Weight (gm.)
Deficient in vitamin B	None	167	121	33	42	152	114	213	305	1·88
		163	134	58	128	366	186	261	360	1·92
		218	170	44	100	227	64	136	136	2·20
		193	151	61	120	187	88	129	136	2·00
		232	209	101	130	390	135	210	189	2·35
		192	167	74	120	317	129	147	157	2·10
	Testosterone	173	131	125	315	1,174	525	395	610	1·92
		159	123	136	505	685	510	384	384	1·80
		170	140	120	327	625	475	311	357	1·82
	Gonadotrophin	175	142	255	400	1,980	2,040	550	810	2·30
		234	174	748	320	2,570	3,860	680	850	2·35
		190	188	275	800	3,875	4,540	650	1,180	2·20
		225	177	230	608	2,170	3,010	490	1,310	2·10
Control	None	165	232	150	520	1,266	970	418	620	1·99
		229	291	134	432	890	900	460	605	2·50
		194	233	120	320	740	680	295	430	2·42
		212	262	125	376	900	790	338	517	2·30
		198	257	134	442	910	920	390	495	2·05
	Testosterone	181	233	137	425	964	695	331	415	1·65
		184	224	121	240	946	700	418	495	1·48
		167	221	155	490	1,050	990	435	570	1·50
	Gonadotrophin	192	258	220	488	1,890	1,800	520	630	2·50
		175	210	280	608	1,600	1,670	440	750	2·41



Effect of chorionic gonadotrophin on the secretion of fructose and citric acid in male accessory organs of vitamin B-deficient and normal rats

chorionic gonadotrophin injected every other day during the last two weeks of the experiment. It will be seen that this large dose of gonadotrophin actually brought about a secretory hyperfunction in the accessory glands of both the deficient and normal rats. However, as regards the spermatogenic activity of the nutritionally deficient animals, microscopic examination of epididymal sperm at the end of the experimental period revealed little change either in motility or in structure, in contrast to the drastic curtailment of the secretory function in the accessory organs.

We are much indebted to Miss Ruby Leader for her help with the animal experiments. We also acknowledge the gift of chorionic gonadotrophin from Dr. W. H. McShan. The work was carried out on behalf of the Medical Research Council (C. L.-M.) and the Agricultural Research Council (T. M.).

[1] Moore, C. R., and Samuels, L. T., *Amer. J. Physiol.*, **96**, 278 (1931).
[2] Lutwak-Mann, C., *Nature*, **164**, 607 (1949).
[3] Lutwak-Mann, C., and Gunz, F. W., *Biochem. J.*, **44**, *Proc.* iii (1949).
[4] Mann, T., and Parsons, L., *Nature*, **160**, 294 (1947).
[5] Mann, T., Davies, D. V., and Humphrey, G. F., *J. Endocrinol.*, **6**, 75 (1949).
[6] Lutwak-Mann, C., Mann, T., and Price, D., *Proc. Roy. Soc.*, B, **136**, 461 (1949).
[7] Mann, T., "Adv. Enzymol.", **9**, 329 (1949).

SOME REACTIONS OF ATOMIC HYDROGEN IN FLAMES

By J. R. ARTHUR

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THIS note describes simple experiments which illustrate the reactions which hydrogen atoms undergo in flames other than recognized chain-branching reactions. Reference is made to: (i) removal of hydrogen atoms in exothermic reactions on other molecules, (ii) the excitation of sodium atoms in flames, and (iii) the formation of carbon in hydrocarbon flames.

A very convenient demonstration of the presence of hydrogen atoms in flames is the luminescence observed when the flame is brought into contact with certain activated oxides; the luminescence has its origin in the reaction $H + H \rightarrow H_2$ which occurs on the oxide surface[1], and is most marked with hydrogen flames.

A study has now been made of the effects on this luminescence of adding gases and vapours to a stream of hydrogen burning at a diffusion flame: the mixtures were passed through a porous refractory block and ignited as they emerged through the top face, which was coated with a calcium oxide base activated by manganese. It was found that the luminescence could be suppressed, the flames appearing to shrink, and in Table 1 the critical amounts (P) of various additives (percentage of total gas) are given. Some of the data are approximate, because in a few cases the exact extinction points were rather difficult to decide, but it is clear that large polyatomic molecules are the most effective.

TABLE 1

Additive	$C_6H_5C_2H_5$	SO_2	$C_6H_5CH_3$	C_6H_{12}	C_3H_8	C_2H_4	CO_2	CH_4
P	1·8	2·3	2·4	2·7	2·9	3·6	6·2	6·6

Additive	CO	NH_3	N_2O	N_2
P	15·4	19·4	29·0	37·0

In these experiments, sodium from the refractory support was a persistent impurity in the hydrogen flames. At the critical amount of additive required to suppress the luminescence, the sodium light was extinguished. These two phenomena coincided and both were reversible, probably indicating a deactivation effect in the flame and not on the solid support.

These observations with hydrogen flames have an interesting counterpart in luminous hydrocarbon flames, which may be rendered non-luminous by foreign gas additions, an effect known for many years[3]. Complete suppression of carbon formation requires large amounts of additives, for example, about 45 per cent carbon dioxide (by volume of the total gas) for an unaerated methane flame. This critical percentage was independent of the size of the flame within the range studied. When luminous flames of methane and ethylene were contaminated with sodium, it was found that the extinction of the sodium light and of the luminosity due to carbon occurred at the same concentration of additive (carbon dioxide or nitrogen). Moreover, less carbon dioxide was needed to prevent carbon formation than when the flame was free from sodium.

Measurements of the light-yield from luminous flames of methane and ethylene to which carbon dioxide and nitrogen were added showed that large effects were occurring at much lower concentrations of the additives than those required for complete suppression of carbon formation. Analogous results were obtained with flames of liquid hydrocarbons (for example, pentane, hexane and heptane).

A likely interpretation of these several observations is as follows. Since the luminescence at the promoted calcium oxide surface (S) has its origin in the change, $H + H + S \rightarrow H_2 + S + h\nu$, it is probable that its suppression by added gases is due to new reactions occurring which remove hydrogen atoms. Since the suppression of the luminescence and of the sodium light coincide, either the generation or electronic excitation of the sodium atoms also appears to be due to a reaction involving hydrogen atoms.

In turn, the coincidence of the suppression of the luminosity (due to carbon) and of the sodium light

in hydrocarbon flames indicates that carbon formation can be prevented either by providing an alternative reaction which consumes hydrogen atoms or a state of affairs which renders them ineffective.

It seems probable that, in the hydrogen and hydrocarbon flames, the gaseous additives function either as third bodies in exothermic reactions leading to the destruction of hydrogen atoms, or as second bodies which effectively reduce the collision frequency of these atoms with each other or with hydrocarbon molecules. In discussing the nature of the former reactions, at least three possibilities may be considered:

(i) $H + H + X \rightarrow H_2 + X$ (X is the additive)
(ii) $H + X \rightarrow H \ldots X$, $H \ldots X + H \rightarrow H_2 + X$
(iii) $H + O_2 + X \rightarrow HO_2 + X$.

As a third-order reaction involving two species present in small quantity, reaction (i) will occur infrequently. Reaction (ii) is an adaptation of (i), involving two consecutive second-order reactions (the second following closely on the first and a 'sticky' collision between H and the additive being assumed). Equation (iii) is more likely to be important, on collision grounds, than (i) owing to the greater concentration of molecular oxygen than atomic hydrogen; but the evidence for the existence of HO_2 in hot normal flames is meagre. The energy change in (iii) being unknown, one cannot decide whether sodium atom excitation (requiring 48·3 k.cal.) could occur due to (iii). Other reactions are possible (for example, involving OH), but it is certain that at least one hydrogen atom is involved.

Even without knowing the exact nature of the key reaction, some conclusions can be drawn. Thus it is known that sodium atoms will emit the D lines by excitation in a hydrogen discharge, and it has sometimes been suspected that their excitation in flames is chemiluminescent; the above experiments lend support to this view, though they do not eliminate a role of hydrogen atoms in the generation rather than in the excitation of sodium atoms. In any event, the matter is relevant to the D-line reversal method of flame temperature measurement, and the sensitivity of hydrogen flames (compared with others) to the presence of sodium is accounted for. Moreover, the relation between the concentration of sodium in flames and the extent to which it is excited will depend much on the chemistry of the flame processes.

The observations with hydrocarbon flames imply that important initiating reactions of carbon formation are of the form:

$$C_nH_m + H \rightarrow C_nH_{m-1} + H_2,$$
$$R{-}CH{=}CHR + H \rightarrow R{-}\underset{|}{CH}{-}CH_2R;$$

the former reaction was invoked[3] to account for the products of reaction from hydrocarbons (other than methane) and atomic hydrogen at room temperature. The stripping or addition of hydrogen atoms will be followed by polymerization of the freshly formed hydrocarbon radicals, the two processes together leading finally to solid carbon formation in flames.

In connexion with the cooling of hydrocarbon flames by additions of foreign gas and with the general question of the effect of temperature on carbon formation, it may be recalled that V. B. Lewes[3] was of the opinion that carbon formation in all hydrocarbon flames was preceded by the formation of acetylene, the strongly exothermic decomposition of which to carbon and hydrogen caused the former to radiate: added gases (carbon dioxide, nitrogen, etc.) lowered the temperature sufficiently for the formation of acetylene to be prevented. The following observation implies, however, that the cooling effect is not all-important in relation to carbon formation. The critical concentration of carbon dioxide required to extinguish the luminosity of a methane flame was found to be unchanged when the mixed gases fed to the burner were preheated: on Lewes's view, more carbon dioxide should have been required.

This work, including relevant spectroscopic measurements, will shortly be reported in full. My thanks are due to several colleagues: Dr. D. T. A. Townsend, in discussing the significance of Smith's luminescence experiments, directed attention to the probable rôle of large molecules as targets for the removal of hydrogen atoms; Dr. D. H. Bangham gave invaluable advice throughout the course of the work; and Dr. M. S. Iyengar assisted with some of the experimental work.

[1] (*a*) Smith, E. C. W., Second Arthur Duckham Research Fellowship Report, Inst. Gas. Eng., 1940. (*b*) Townend, D. T. A., Jubilee Memorial Lecture of the Society of Chemical Industry, *Chem. and Indust.*, **23**, 346 (1945). (*c*) Townend, D. T. A., lecture to the annual general meeting of the Gas Research Board, 1949; see Gas Research Board Paper, "The part played by hydrogen atoms in combustion processes", by J. R. Arthur and D. T. A. Townend (in the press).
[2] Bonhoeffer, K., and Harteck, P., *Z. phys. Chem.*, **139**, 64 (1928).
[3] Lewes, V. B., *Trans. Chem. Soc.*, **69**, 322 (1892); *Proc. Roy. Soc.*, **55**, 90 (1894); **57**, 344 (1895).

PLASTIC FLOW OF UNMATURED LINOLEUM

ON January 23, the Linoleum Research Council held a symposium at the Grosvenor Hotel, London, the subject being "The Plastic Flow of Unmatured Linoleum". About forty people were present, of whom more than half were men of science and technologists from the linoleum industry. In opening the meeting, Mr. T. McQuillen, chairman of the executive committee, pointed out that the policy of the Linoleum Research Council is to endow research in suitable institutions and to supplement this effort by encouraging co-operative research within the industry; the symposium was the outcome of the second line of approach. Dr. S. R. W. Martin, the superintendent of research, then explained the programme for the day, and pointed out that six papers would be presented, which had been circulated at least a week beforehand. Each contributor was allowed 15–20 minutes to outline the salient points of his paper, and at the end of the proceedings time was given for a general discussion.

Mr. A. G. Ward (director of the British Gelatine and Glue Research Association) outlined work on the rheology of unseasoned linoleum which he has carried out at the Building Research Station, Watford, for Messrs. Michael Nairn and Co., Ltd., the primary object being to evolve a technique which could be used for research purposes and routine control, and the results of which could be correlated with actual behaviour of material in a calender. He emphasized that, although in industry formulæ are made up on a weight basis for convenience, it is the volume ratio of the constituents which is of importance in work of this nature, and in the first part of his paper he described methods for determining the true density of some of the components of a linoleum mix – ground cork, specific gravity 1·25. After preliminary

experiments of an exploratory nature on the flow of linoleum compositions, an extrusion technique was evolved. Calendering, of course, can in many respects be considered as two-dimensional extrusion. It is possible with such an apparatus to work with pressures which are of approximately the same order of magnitude as those in use on an actual calender. The extrusion apparatus described can be used with a series of nine extrusion nozzles (three different lengths, each of three different diameters) in order to measure end effects, or with one nozzle for routine testing. Mr. Ward discussed the significance of the results he has obtained in relation to the manufacture of linoleum, particularly with respect to the effects of combined hydrostatic pressure and shearing stress as in the calendering process.

An extrusion apparatus, which has been developed from the prototype outlined by Mr. Ward, was described by Messrs. F. T. Walker and J. Arnot (Michael Nairn and Co., Ltd.). By extruding unseasoned linoleum in this apparatus, the behaviour under calendering conditions and the effect exerted by the various conventional fillers can be demonstrated. The relationship between temperature and extrusion-rate at constant pressure, for linoleum mixes containing known volumes of fillers, was shown in a series of curves. A constant factor appears to exist between the equivalent amounts of any two fillers which have the same effect on flow. Apart from sheet formation, marble and other decorative effects are dependent on the flow characteristics of the unseasoned mix. A few curves of related floor-coverings, for example, asphalt tile and polyvinyl-chloride flooring, were given. The problem of solid–liquid mixtures was examined by Mr. P. Rigden (Road Research Laboratory, Harmondsworth). He quoted information derived from filler-binder systems as used in the road-building industry and showed how the analysis of rheological data gives information of the structure and make-up of the particular system. In a practical paper describing the use of a penetrometer-type instrument to measure the deformation of unmatured linoleum, Mr. C. W. Falkner (Linoleum Manufacturing Co.) gave some interesting facts correlating results obtained on this instrument with composition of the sample under test. An attempt has been made to study quantitatively the flow properties of the linoleum plastic mix, with special reference to changes in workability and plasticity with temperature.

A method of evaluation of the rheological properties of linoleum composition was described by Messrs. G. D. Rack and F. J. Rigby (Jas. Williamson and Son, Ltd.), which is based on a creep-curve method, one that needs only the simplest of apparatus. In practice, samples of linoleum composition after calendering are cut into strips of standard length and the rate of extension measured with different applied stresses. Experimental work shows the effect of mixing-time on linoleum compositions containing all cork (or wood flour) as the cellular filler, the effect of the type of filler and the effect of the age of the sheet. Although there are certain limiting factors to the use of this technique, the method needs no expensive apparatus and is within the reach of all investigators. Mr. R. W. Whorlow (Research Association of British Rubber Manufacturers) described the relative merits of various types of instruments used for the measurement of plasticity in the rubber industry and, in particular, discussed the merits of the rotational instruments used, which in some cases had been deprecated during the discussion at the symposium. The methods of using these various instruments and possible ways of modifying them to be of use to the linoleum industry were dealt with.

In summing up, Mr. Ward said that certain points stand out very clearly; one of them, the measurement of composition on a volume basis, is a fruitful approach. He suggested that by making a start with the binder in the composition and by studying its properties in detail, in a similar way to the work which has been carried out at the Road Research Laboratory, some important and interesting data could be obtained. Mr. Ward was of the opinion that, although the extrusion type of apparatus is particularly useful, there may be a limit to its usefulness, and it is not easy to separate certain effects. The theory of calendering was discussed at the symposium, and this is tied in many ways to extrusion; but he suggested that the industry should also consider other fields, that is, in the early stages of manufacture, as calendering is not the only process used in making linoleum.

QUANTITATIVE ECOLOGY OF PLANKTON

THE population of plankton organisms in the sea is composed of plants and animals of very assorted sizes and shapes. Of these, the microscopic plants are producers, and the smaller animals are consumers—but also producers of fish-life. The productivity of the sea is dependent upon a complex of physical and chemical conditions, chief among which are the radiation of the sun and nutrient substances containing phosphorus and nitrogen.

Our knowledge of this many-sided picture is now sufficiently detailed to allow attempts at mathematical treatment. The accumulation of the necessary data has taken many years of painstaking and sustained research in many directions, much of which has needed the elaboration of special methods. By this means quantitative knowledge has been obtained on the seasonal and regional changes in amounts of nutrient salts, the penetration of the sun's radiation into the sea, and the conditions leading to stability or unstability of the water column and hence the turbulence.

The collection of the information on the living populations, although it was started earlier, has been slower and less organised, largely owing to the varied interests of the research workers. First, the constituent members of the flora and fauna had to be described and identified; studies of their comparative abundance and seasonal and regional distribution were ends in themselves, as were their life-histories. But when sufficient was known, attempts were soon made to correlate the seasonal and other changes in the populations with the physical and chemical conditions. In general, these correlations have been expressed in numbers of different individuals of the population. Perhaps this was rather natural, since estimations were chiefly made by botanists and zoologists who had interests in the organisms as such. But a correct assessment of the overall production can only be made by chemical means. Information on photosynthesis, respiration, and metabolism of plankton plants and animals has been obtained by experiment. Assessment of quantity of plant life in

unit volumes of sea-water has been made by estimation of the amount of plant pigment, and data on volumes, dry weight and composition of representative plankton animals have been obtained.

By the use of reasonable average-constants for all the factors concerned in an evaluation of the dynamics of a plankton population, G. A. Riley showed that it was possible to produce equations which gave promise that theoretical treatment might provide an understanding of the fundamental processes controlling plankton growth and distribution. In subsequent work he found that with selected seasonal data from different regions the changing abundance of the population could be predicted with a fair degree of approximation using theoretical equations. His latest collaboration, with H. Stommel and D. F. Bumpus[1], is an attempt to examine the principles of regional distribution.

This work and its predecessors deserve close attention by ecologists. They emphasize gaps in our knowledge, and perhaps impress upon us most the need to come to agreement on the best methods of quantitative assessment of the varying populations. The fact that the synthesis of the picture has advanced so far that it is amenable to mathematical expression should in itself act as a stimulus for renewed efforts.

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[1] Riley, G. A., Stommel, H., and Bumpus, D. F., "Quantitative Ecology of the Plankton of the Western North Atlantic". *Bull. Bingham Oceanogr. Collection*, **12**, Art. 3, 1 (1949).

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

ANNUAL REPORT

THE forty-second annual report of the governing body of the Imperial College of Science and Technology* covers the year ended July 31, 1949, and, besides the statement of accounts, contains a list of publications during the year, arranged by departments, and a list of changes in the teaching and administrative staff. The number of full-time students during the year was 1,428, as against 1,510 in 1947–48, and of these 87 came from foreign countries, 140 from the Commonwealth overseas and 406 from the British Isles outside a radius of thirty miles from the College. The total of academic distinctions for 1948–49 was 800 as compared with 875 in 1947–48, 700 in 1946–47 and 618 in 1939–40.

Among important educational developments noted in the report are the offer by the trustees of the Rockefeller Foundation of £27,200 to cover the cost during 1949–52 of a research fellow in public health engineering at the College and a tutor at the London School of Hygiene and Tropical Medicine. Standard Telephones and Cables, Ltd., has contributed £1,200 per annum for seven years towards the establishment of the Henry Mark Pease readership in telecommunications, while the University Grants Committee has financed the further development of geometrical optics in the Technical Optics Section of the Physics Department. Proposals for research work and training at a high level in mineral dressing are being implemented through a recurrent grant of £6,500 per annum from the University Grants Committee, and application has been made for a capital grant for the reorganisation and modernization of the Bessemer Laboratory for this purpose.

The report also refers to the revision of building plans with the idea of allocating the ground now available to the more urgently needed buildings: plans for a new aeronautics building, an extension of the Unwin building and a further extension of the chemical technology building have already been submitted. Completion of these immediate projects will also provide for an extension of the Biological Departments. As a first step towards the encouragement of cultural studies and giving students the opportunity of preparing themselves also for life in its broader aspect, a course of lectures on "Ends and Means in Science" has been arranged, to be given by professors of the College to members of the College as a whole.

* Forty-second Annual Report of the Governing Body of the Imperial College of Science and Technology. Pp. 53. (London: Imperial College of Science and Technology, 1949.)

FOREST POLICY IN UGANDA

ANNUAL REPORT FOR 1948

DURING 1948 the turning point in forestry seems to have been made in Uganda. The report for the year* commences with the following paragraph: "Russia continues to have a series of five-year plans. In Uganda we have a general development ten-year plan. Now His Excellency the Governor has produced a plan for centuries—a statement on Forest Policy. For the first time since the Forest Department was formed they have been given a real directive." Of course, these things have been said before, but it would appear that Uganda, through its Governor, has envisaged a real forest policy. Briefly the points are: "(1) To reserve in perpetuity, for the benefit of the present inhabitants of Uganda and of posterity, sufficient land (either already forested or capable of afforestation) to maintain climatic conditions suitable for agriculture, to preserve water supplies, to provide forest produce for agricultural, industrial and domestic purposes, and to maintain soil stability in areas where the land is liable to deterioration if put to other uses. (2) To manage the forest estate to obtain the best financial returns on its capital value and the expenses of management, in so far as such returns are consistent with the primary aims set out above. (3) To foster, by education and propaganda, a real understanding among the people of Uganda of the value of forests to them and their descendants. (4) To encourage and assist the practice of sound forestry by Local Authorities and private enterprise; and to educate selected Africans in technical forestry."

The work described in this report gives confidence that a start has been made with putting into force this suggested forest policy, and it is to be hoped that the effort will be maintained. So often in the past these suggestions of forest policy have been announced, only to be entirely ignored by subsequent governors and their councils, usually on the score that the Colony is in financial difficulties, and therefore the forest policy is one of the first things to suffer. Moreover, no announcement of a new forest policy, and even its introduction by the governor concerned, is of any use unless the strength of the forest department is sufficient to carry out the plan. In the past this has certainly not been the case with the forest departments in East Africa.

* Uganda Protectorate. Annual Report of the Forest Department for the Year ended 31st December, 1948. Pp. ii+57. (Entebbe: Government Printer, 1949.) 2s.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Fission and Nuclear Shell Model

THE importance of the 'magic' neutron numbers 50 and 82 has been repeatedly stressed[1]. It has been suggested that these numbers of neutrons form shells of considerable stability, and that additional neutrons, if present, are more loosely bound. It seems possible that such a shell may persist as a definite structure at moderate excitation of the nucleus, the excitation energy being shared by the nucleons not contained in the closed shell.

The purpose of the present communication is to point out that this shell model suggests an interpretation of observed features of the fission process, both in uranium-235 and bismuth-209.

When uranium-235 suffers fission upon impact of a slow neutron, the two fragments formed contain altogether 144 neutrons, of which a few are afterwards evaporated. This makes it possible to give each fragment a complete shell, one of 50, the other of 82 neutrons. In the most probable form of fission the remaining neutrons will presumably be distributed more or less equally between the two fragments. Actually it is known that the mass ratio of the two fragments formed in the most probable mode of fission of uranium-235 is not far from 82 : 50.

It is reasonable to assume that, if the shells of 50 and 82 neutrons persist in the most probable mode of fission, the division of charge of a pair of primary fragments is conditioned by this persistence of the neutron shells. This means that only those charges are possible which possess a closed shell of 50 and 82 neutrons respectively. As the closed shell of 50 neutrons is found connected with $Z \geqslant 36$ and of 82 neutrons with $Z \geqslant 54$, and as the sum of the charges of the two primary fragments must be equal to 92, it follows that, for the lighter fragment, the charge can only be $Z = 36$–38, and the corresponding charge of the heavier fragment 56–54. The agreement of this conclusion with the experimental results[2] is striking. In the range of fission yields between 4·6 and 6·3 per cent, eight chains of the light fission fragment begin with $Z = 36$, and seven chains of the heavy fragment with $Z = 54$.

That the charge of a given mass of primary fragment may vary by some units can easily be derived from the stable end-products in corresponding chains. For example, for the mass pair 91 and 143, the sum of β-disintegrations derived from the charges of the stable end-products is eight, while experimentally ten β-disintegrations were found. What actually is measured in the experiments is the superposition of three fission processes beginning with $Z = 36$, 37 or 38 for the lighter primary fragment, and with $Z = 56$, 55 or 54 for the corresponding heavier primary fragment. These different charges of the primary fragments, that is, different lengths of chains, may account for the observed variation in kinetic energy of a given mass[3].

I should also like to point out that the fission yield curve is rather symmetrical relative to the two maxima belonging to the most probable mode of fission.

In the fission of bismuth[4] by deuterons of 200 MeV. energy, it seems that an average of about twelve neutrons evaporate before fission occurs. Hence only about 116 neutrons are available for the two fragments, and it is not possible to form a shell of 82 in addition to a shell of 50. It seems plausible, then, that both fragments should contain a shell of 50, and again the additional neutrons are distributed more or less equally between the two fragments. Indeed, it was found that the most probable mode of fission of bismuth is symmetrical at charges which are connected with a closed shell of 50 neutrons.

It is interesting to point out what happens when uranium is bombarded by very fast particles. One might then expect a more symmetrical distribution of fission fragments, because the shell structure cannot persist in a highly excited nucleus. Moreover, if a considerable number of neutrons (say, twenty) can be evaporated before fission occurs, the symmetrical mode would also be the most probable one. Bombardment with α-particles of 360 MeV. produced, indeed, predominantly symmetrical fission[5].

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[1] Mayer, M. G., *Phys. Rev.*, **74**, 235 (1948). Glendenin, L. E., *Phys. Rev.*, **75**, 337 (1949).
[2] Plutonium Project, *Amer. Chem. Soc.*, **68**, 2411 (1946).
[3] Brunton, D. C., and Hanna, G. C., *Phys. Rev.*, **75**, 990 (1949).
[4] Goeckerman, R. H., and Perlman, I., *Phys. Rev.*, **73**, 1127 (1948).
[5] O'Connor, P. R., and Seaborg, G. T., *Phys. Rev.*, **74**, 1189 (1948).

Radar Reflexions from Auroras

RADIO echoes on a frequency of 46 Mc./s. have been reported by Lovell, Clegg and Ellyett[1]. They have been observed also on a frequency of 32·7 Mc./s. by McKinley and Millman[2], incidental to their studies of meteor ionization. More recently, a systematic search for such echoes has been made at Saskatoon, Canada, using radar equipment having frequencies of 3,000 Mc./s. and 106·5 Mc./s. During this search, echoes have been observed regularly on the lower frequency but not at all on the higher one.

The 3,000-Mc./s. unit is equipped with an aerial system consisting of two paraboloids with apertures of 150 cm. and giving an approximate beam-width of 3·5°. Orientation of the aerial system about horizontal and vertical axes is under the control of the radar operator. The peak transmitter power is 50 kW. The 106·5-Mc./s. unit is equipped with a directive aerial which can be rotated only about a vertical axis. The maximum power from the primary and secondary lobes of the beam is radiated at about 4·0° and 14·3° respectively with the horizontal. The horizontal beam-width is about 25°. The peak transmitter power is 50 kW. It is estimated that the power in the secondary lobe is about one-third that in the primary. As a result, the search for echoes with this unit is limited to auroras at distances of 600–1,000 km. For both systems the electric vector is horizontal. An auroral camera, modified to use 35-mm. film, is used to photograph the sky in front of each aerial system.

A careful search for echoes with the 3,000-Mc./s. unit during seventeen auroral displays (including the very active and intense one of January 24, 1949[3]) failed to show any that could be distinguished on the receiver from the 3,000-megacycle pulses of radiation emitted by the aurora[4]. On the other hand, persistent and well-defined echoes are observed with the

106·5-Mc./s. unit whenever bright auroral arcs and bands are located in the direction toward which the primary beam is emitted. Because of the inherently large cross-section of this radar beam and the distances of the auroras (600–1,000 km.) from which the reflexions are observed, it is impossible to say for certain whether the reflexions occur from the lower and brighter parts of the auroral forms or from levels a few kilometres above them. In any event, the positions of the reflecting regions as determined by the radar equipment agree closely with the positions of the auroral forms as determined from single-station photographs on the assumption that the lower edge of arcs and bands are at a constant height of 110 km. above the earth's surface.

The possibility that such echoes occur from the vertical surfaces of auroral discharges at the point where the radius from the radar station is normal to the surface of the discharge[5] and, hence, normal to the lines of the earth's magnetic field, could not be disproved, because of the limitations on the altitude of the primary radar beam and of the location of auroras distant from Saskatoon. However, the appearance of the echoes on the radar oscilloscopes and the range of distances (sometimes up to 300 km.), over which the echoes are observed during sweeps of the aerial, suggest that they are similar to radio echoes from the ionosphere. If such is the case, an application of the formula for the critical frequency[6],

$$N = 1{\cdot}24 \times 10^{-8} f^2,$$

where N is the electron density/cm.^{3} and f is the ordinary ray critical frequency in c./s., gives a minimum ionization density of $1{\cdot}4 \times 10^9$ electrons/cm.^{3}, for the regions from which the echoes are observed.

It is probable that these regions of high electron density are also the ones from which the short pulses of radiation are emitted[4]. Streams of particles entering the earth's atmosphere may produce an electron plasma and provide the energy for a plasma-type of oscillation. Applying the formula for the frequency of oscillation of such a plasma[7],

$$f' = \left(\frac{e^2 n}{\pi m}\right)^{1/2},$$

where f' is the frequency of oscillation (3,000 Mc./s. in this case), e and m are respectively the charge and mass of the electron, and n is the electron density of the plasma in electrons/cm.^{3}, a value of $1{\cdot}1 \times 10^{11}$ electrons/cm.^{3} is obtained for the plasma. The limited volumes over which these high ionizations occur, together with the rapid diffusion of the electrons after the passage of the ionizing particles, is probably the reason why reflexions are not observed with the 3,000 Mc./s. unit.

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[1] Lovell, Clegg and Ellyett, *Nature*, **160**, 372 (1947).
[2] McKinley and Millman (private communication).
[3] Petrie, Forsyth and McConechy, *Nature*, **163**, 774 (1949).
[4] Forsyth, Petrie and Currie, *Nature*, **164**, 453 (1949).
[5] Herlofsen, *Nature*, **160**, 867 (1947).
[6] Appleton and Builder, *Proc. Phys. Soc.*, **45**, 208 (1933).
[7] Tonks and Langmuir, *Phys. Rev.*, **33**, 195 (1929).

Young's Modulus as a Function of Wire Diameter

It was observed that, during annealing, the modulus of elasticity of copper wires may be appreciably lowered[1]. This phenomenon has been explained by Barrett[2] as resulting from alterations in their textures. As has been shown by Schmid and Wassermann[3], most metals with a face-centred cubic structure such as copper, silver or gold exhibit a double fibre structure when cold drawn. This double texture consists of crystals the [111] or [100] directions of which are parallel to the axis of the wire. In copper, for example, 40 per cent of the grains are oriented in the [100] and 60 per cent in the [111] direction. Body-centred cubic metal wire, such as iron, tungsten and molybdenum, was found to have a simple [110] texture[4,5].

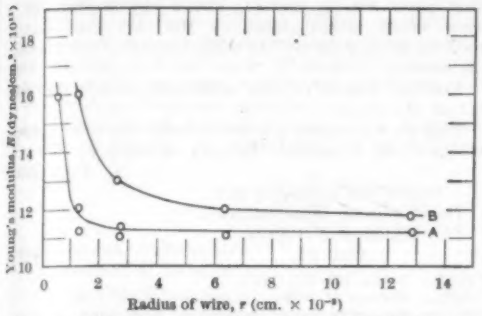
In most metals, Young's modulus changes appreciably with the crystallographic direction[6]. Tungsten, however, is completely isotropic in this respect. It is obvious, then, that with a change in texture the variation in modulus of elasticity should be expected, and indeed, during the drawing of the wires to smaller diameter, a tendency towards simplification of the texture was observed.

The Young's moduli of copper, nickel, platinum and tungsten wires of various diameter were determined by means of the apparatus described elsewhere[7]. The accuracy of measurements was better than 5 per cent. The results are listed in the accompanying table. All face-centred cubic metals show appreciable increase of the modulus of elasticity with decrease of diameter of the wire in the annealed and cold-worked states.

Metal	Diameter in μ	$E\left(\frac{\text{dynes}}{\text{cm.}^2} \times 10^{11}\right)$	Heat treatment
Copper	258·0	11·0	Annealed in vacuum at 400° C. for 10 min.
	128·5	10·9	
	54·8	10·8–11·2	
	26·1	11·0–11·8	
	10·6	15·6	
	256·0	11·6	
	127·0	11·6	Cold drawn
	53·0	12·8	
	25·4	15·8	
Nickel	238·0	20·1	Cold drawn
	120·0	20·5	
	25·1	22·0	
Platinum	126·7	15·5	Annealed in vacuum at 850° C. for 10 min.
	24·1	18·1	
Tungsten	129·5	32·7	Drawn
	14·2	32·7	

In the case of copper, where the entire series of measurements was run for annealed as well as for hard-drawn wires, the Young's modulus of any annealed wire was found always to be lower than that of the wire of the same radius but in the cold-worked condition. The graph showing these changes for copper is reproduced herewith. Curve A refers to annealed and B to cold-drawn wires. Tungsten, because of its elastic isotropy, shows no variation in modulus.

The observed large variations in the modulus of elasticity of some face-centred metals with diameter and heat treatment are due to their elastic anisotropy and changes in their textures. In copper, Young's modulus in the [111] direction is $E_{111} = 19{\cdot}0 \times 10^{11}$ dynes/cm.^{2}, and in the [100] $E_{100} = 6{\cdot}6 \times 10^{11}$ dynes/cm.^{2}, leaving great possibilities for variations which were actually observed. These changes cannot be due to the modification of the zonal texture which Schmid[8] found in the case of metals of face-centred structure. In such textures, the grains become more perfectly oriented as the centre of the wire is



Young's modulus for copper wires as a function of radius r. (*A*) Annealed wires; (*B*) hard-drawn wires

approached. The amount of disorder due to the zonal texture, however, is very small and cannot account for the observed increase in the modulus of elasticity, which was as large as 50 per cent in our case. This, together with the fact that the simple, isotropic texture of tungsten does not exhibit any changes upon being drawn to a smaller diameter, indicates that the variations of Young's modulus with the wire diameter result from the increase of the [111] component of the texture during drawing. This change is not completely destroyed by annealing. From the relation

$$\frac{1}{E} = \frac{X_{111}}{E_{111}} + \frac{X_{100}}{E_{100}},$$

where E is the observed Young's modulus and X_{111} and X_{100} are the fractions of crystals in the wire oriented in [111] and [100] directions respectively, one can roughly evaluate these changes in the texture. Thus, in annealed copper wires, the [111] component increases from 61 per cent to 88 per cent as the wire diameter decreases from 258 μ to 10·6 μ. In the case of cold-drawn wires, the same change is achieved with the wires drawn down only to 25 μ diameter. Similar calculations could be made for nickel or platinum if their double textures were known.

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[1] Phillips, A. J., and Smith, A. A., *Proc. Amer. Soc. Test. Mat.*, **36**, (2). 263 (1936).
[2] Barrett, C. S., "Structure of Metals", 457 (McGraw-Hill Book Co., Inc.).
[3] Schmid, E., and Wassermann, G., *Z. Phys.*, **42**, 779 (1927).
[4] Ittisch, M., Polanyi, M., and Weissenberg, K., *Z. Phys.*, **7**, 181 (1921).
[5] Jeffries, Z., *Trans. Amer. Inst. Mech. Eng.*, **70**, 303 (1924).
[6] Schmid, E., and Boas, W., "Kristallplastizität", 202 (Berlin, 1935).
[7] Norton, J. T., and Kuczynski, G. C., *Instruments*, **21**, 4, 328 (1948).
[8] Schmid, E., and Wassermann, G., *Z. Metallk.*, **19**, 325 (1927).

Preparation of Methanol Labelled with Isotopic Carbon

PERHAPS the most important single step in the preparation of compounds labelled with a carbon isotope is the reduction of carbon dioxide to methanol. Three suitable methods for this purpose have been described, namely: (i) the hydrogenolysis of methyl formate[1,2] (from formic acid prepared by reduction of carbon dioxide), (ii) the catalytic hydrogenation of carbon dioxide[3] (at 285°, 450 atmospheres pressure), and (iii) the reduction of carbon dioxide by means of lithium aluminium hydride[4]. The latter method would appear to offer some obvious practical advantages; but we have shown that the purity of methanol so prepared leaves much to be desired.

The lithium aluminium hydride method requires the use of diethyl carbitol as solvent for the hydride and of butyl carbitol for effecting alcoholysis of the reduction product, $LiAl(OCH_3)_4$. We have found, however, that under the conditions of the experiment these solvents may decompose with the formation of ethanol and butanol respectively. As separation of methanol from such contaminants is difficult on the micro-scale, we have used solvents which cannot afford such volatile by-products. The most satisfactory of these were tetrahydro-furfuroxy-tetrahydro-pyran (solvent for lithium aluminium hydride) and tetrahydro-furfuryl alcohol (for alcoholysis), the former being readily prepared by reaction of Δ^2-dihydropyran with tetrahydro-furfuryl alcohol[5].

The preferred technique for reduction of carbon dioxide was as follows. A 0·8 *M* solution of lithium aluminium hydride (2 equivalents) in the above-mentioned solvent was prepared under a blanket of nitrogen and was allowed to react with dry carbon dioxide from a reservoir; absorption of the gas was always complete. Twelve equivalents of tetrahydrofurfuryl alcohol was added to the reaction mixture, which was then heated at 110° under 60 mm. pressure, to expel the methanol, which was stripped from the resulting distillate by normal vacuum technique, leaving a small residue of high-boiling liquid. The methanol was of high purity and contained only very small amounts of water, formaldehyde and tetrahydrofurfuryl alcohol. The results of comparative experiments are given in the table.

Substance	n_D^{20}	d_4^{20}	Impurities	Yield
(1) CH_3OH prepared by use of diethyl and butyl carbitols	1·338	0·82	Water, HCHO C_2H_5OH,C_4H_9OH	75–80% of CH_3OH
(2) CH_3OH prepared by use of solvents described above	1·334	0·793	Water, HCHO	*c.* 90% of CH_3OH
(3) Pure CH_3OH	1·329	0·792	—	—
(4) CH_3I prepared from (1)	1·524 (25°)	—	C_2H_5I,C_4H_9I	65–75% (on CO_2)
(5) CH_3I prepared from (2)	1·530	2·24	none	77–85% (on CO_2)
(6) Pure CH_3I	1·530	2·28	—	—

By means of a Zeisel reaction (followed by removal of iodine, hydriodic acid and water from the product), methanol was converted to methyl iodide in 77–85 per cent yield, based on the carbon dioxide taken. The methyl iodide so prepared was pure, as judged by physical constants and chemical analysis (found: I, 88·9; calc. for CH_3I: I, 89·4 per cent).

The procedure described has been satisfactorily applied to syntheses involving the use of isotopic carbon atoms.

This note is published by permission of the Director of the Chemical Research Laboratory.

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[1] Harman, Stewart and Ruben, *J. Amer. Chem. Soc.*, **64**, 2293 (1942).
[2] Melville, Rachele and Keller, *J. Biol. Chem.*, **169**, 419 (1947).
[3] Tolbert, *J. Amer. Chem. Soc.*, **69**, 1529 (1947).
[4] Nystrom, Yanko and Brown, *J. Amer. Chem. Soc.*, **70**, 441 (1948).
[5] Woods and Kramer, *J. Amer. Chem. Soc.*, **69**, 2246 (1947).

Thermal Decomposition of Organic Nitrates

In an earlier note[1], the basic mechanism proposed for the thermal decomposition of the organic nitrates was :

$$R\mathrm{CH_2ONO_2} \rightarrow R\mathrm{CH_2O}— + \mathrm{NO_2}$$
$$R\mathrm{CH_2O}— \rightarrow \tfrac{1}{2}\, R\mathrm{CH_2OH} + \tfrac{1}{2}\, R\mathrm{CHO},$$

followed by oxidation-reduction reactions between nitrogen dioxide and aldehydes.

It has recently become evident[2] that the initial step is followed by the recombination reaction :

$$R\mathrm{CH_2O}— + \mathrm{NO_2} \rightarrow R\mathrm{CH_2ONO_2},$$

since nitrogen dioxide, initially added, retards the reaction, the retardation being roughly proportional to the amount added. Furthermore, the disproportionation of the alkoxyl radical shown above is improbable since it involves collision between identical radicals, the reactions

$$R\mathrm{CH_2O}— + R\mathrm{CH_2ONO_2} \rightarrow \underset{|}{R\mathrm{CHONO_2}} + R\mathrm{CH_2OH}$$
$$\underset{|}{R\mathrm{CHONO_2}} \rightarrow R\mathrm{CHO} + \mathrm{NO_2}$$

being more probable[3].

On the above basis, kinetic equations can be formulated which will account for the retardation of the reactions by nitrogen dioxide, and for the peculiar initial linearity and subsequent first-order behaviour often observed in the p/t curves obtained in overall decomposition studies[3].

With mono-nitrates of C_3 and above, it appears that the alkoxyl radical may also undergo C—C bond fission to form an alkyl radical and formaldehyde, as suggested by Hinshelwood[4]; thus formaldehyde is a decomposition product of *n*-propyl nitrate.

It is noted that Theile[5] has recently proposed two different mechanisms for the decomposition of ethyl nitrate, of which that for 600° C./1 atm. agrees with the above, except that no recombination is postulated. At 250° C. and 16 mm. pressure, however, a different mechanism is proposed, namely :

$$\mathrm{C_2H_5ONO_2} \rightarrow \mathrm{C_2H_5O}— + \mathrm{NO_2} \quad (1)$$
$$\mathrm{C_2H_5O}— \rightarrow \mathrm{CH_2}— + \mathrm{CH_2O} \quad (2)$$
$$\mathrm{CH_2}— + \mathrm{C_2H_5ONO_2} \rightarrow \mathrm{CH_2O}— + \mathrm{C_2H_5ONO} \quad (3)$$
$$\mathrm{CH_2O}— + \mathrm{C_2H_5ONO} \rightarrow \mathrm{CH_2O_2} + \mathrm{C_2H_5ONO} \quad (4)$$
$$\mathrm{CH_2O_2} \rightarrow \mathrm{CH_2O} + —\mathrm{OH} \quad (5)$$
$$\mathrm{CH_2O}— + —\mathrm{OH} \rightarrow \mathrm{CH_2O} + \mathrm{H_2O} \quad (6)$$
$$\mathrm{CH_2O} \rightarrow \mathrm{CO} + \mathrm{H_2} \quad (7)$$

The products identified differ from those found by me and by Bawn and Adams[6], in that they contain ethyl nitrite and no acetaldehyde.

While it is agreed that C—C bond fission may occur in the ethoxyl radical at the low pressures used by Theile (vide Rice and Rodowskas[7]), detailed criticism of Theile's work is difficult because of the lack of detail; but the above mechanism is open to doubt on several counts. Thus it is difficult to see why the methoxyl radical abstracts oxygen from an ethyl nitrate radical at 250° C. if the ethoxyl radical reacts in the normal way, that is, it abstracts hydrogen, at 600° C.

Furthermore, Rice and Teller[8], in their considerations of probable reactions between free radicals and organic molecules on the basis of the principle of least motion, point out that reactions between radicals and negative groups are less probable than those with positive groups or atoms, a rule which in general is supported by a weight of experimental evidence. On this basis, therefore, it would appear that reactions (3) and (4) above are improbable, a view which is supported by the fact that methyl radicals readily methylate trinitrotoluene[9] (cf. reaction (3) above).

Further details of this work will shortly be published elsewhere.

This communication is published with the approval of the Chief Scientist, Ministry of Supply.

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Explosives Research and
Development Establishment,
Ministry of Supply.
Oct. 21.

[1] Phillips, *Nature*, **160**, 753 (1947).
[2] Phillips, Ministry of Supply (unpublished work, 1948).
[3] Phillips, Ministry of Supply (unpublished work, 1948).
[4] Hinshelwood, "The Labile Molecule", Faraday Society Discussions, No. 2, 112 (1947).
[5] Theile, *Angew. Chem.*, **A**, 65 (March 1948).
[6] Bawn and Adams, *Trans. Farad Soc.* (May 1949).
[7] Rice and Rodowskas, *J. Amer. Chem. Soc.*, **57**, 350 (1935).
[8] Rice and Teller, *J. Chem. Phys.*, **6**, 493 (1938).
[9] Fieser *et al.*, *J. Amer. Chem. Soc.*, **64**, 2052 (1942).

Retarding (Inhibiting) and Sensitizing Effects of Nitrogen Dioxide in Alkyl Nitrate Decompositions

The primary step in the decomposition of alkyl nitrates is considered to be the breaking of the O—N bond[1,2,3]. Phillips[4] has shown that such decompositions are retarded by initially added nitrogen dioxide, and he has suggested that this primary step is an equilibrium reaction

$$R\mathrm{CH_2ONO_2} \rightleftharpoons R\mathrm{CH_2O}— + \mathrm{NO_2}.$$

We have shown that this is so in the case of ethyl nitrate by determining the initial rates of decomposition when increasing amounts of nitrogen dioxide are added to a fixed partial pressure of the nitrate. The expected relationship holds up to a certain concentration for the added nitrogen dioxide, when the rate begins to increase again. Since the final products, due to oxidation of acetaldehyde and ethanol by nitrogen dioxide, are not affected by the initial addition of nitrogen dioxide, this increase in rate points to a catalytic process, similar to the effect of nitric oxide on the decomposition of acetaldehyde[5].

Phillips[4] also showed that nitric oxide did not affect the rates of decomposition, and we have confirmed this for ethyl nitrate. It appears that the recombination process $R\mathrm{CH_2O}— + \mathrm{NO} \rightarrow R\mathrm{CH_2ONO}$ occurs at a much slower rate. Steacie[6] did not report any experiments of adding nitric oxide to decomposing alkyl nitrites, but no effect is to be expected; and the crucial experiment to substantiate the similarity in the two groups of decompositions will be to test the supposition that nitrogen dioxide will retard the decomposition of alkyl nitrites.

Though a flame can be initiated on sparking methyl nitrate vapour in the closed system[7], no flame can be induced in ethyl nitrate vapour, at least, not up to 7·5 cm. mercury initial pressure. But if 2–3 per cent of nitrogen dioxide is added to the nitrate vapour, a flame will be propagated, and if the percentage of nitrogen dioxide is increased, the flame goes faster. Norrish and Foord[8] showed that methane increased the induction period for the nitrogen dioxide sensitized hydrogen–oxygen reaction, and if methane is added to a mixture of nitrogen dioxide and ethyl nitrate so that the composition of the mixture is 6 per cent methane, 6 per cent nitrogen dioxide and

88 per cent ethyl nitrate, a flame cannot be induced on sparking. If more nitrogen dioxide is added to that mixture so that its concentration is approximately doubled, a flame can be propagated once more. The role of the methane is probably similar to that in the hydrogen–oxygen reaction.

Acknowledgment is made to the Chief Scientist, Ministry of Supply, for permission to publish this work.

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[1] Appin, A., Charlton, J., and Todes, O., *Acta Physicochimica Acta, U.R.S.S.*, **5**, 655 (1936).
[2] Bawn, C. E. H., and Adams, *Trans. Farad. Soc.*, **45**, 494 (1949).
[3] Phillips, L., *Nature*, **160**, 753 (1947).
[4] Phillips, L. (private communication).
[5] Smith, J. R. E., and Hinshelwood, C. N., *Proc. Roy. Soc.*, A, **180**, 237 (1942).
[6] Steacie, E. W. R., "Atom and Free Radical Mechanisms" (Amer. Chem. Soc. Monograph No. 102).
[7] Zeldovich, Y. B., and Shavlov, Yu. Kh., *J. Phys. Chem., U.S.S.R.*, **20**, 1359 (1946).
[8] Norrish, R. G. W., and Foord, S. G., *Proc. Roy. Soc.*, A, **152**, 196 (1935).

The Ion $N_2O_3^+$. Binding by One-Electron Transfer

It has been shown spectroscopically (the evidence will be published shortly[1]) that the nitrosonium ion in solution forms a molecular compound with nitrogen dioxide: $\overset{+}{N}O\,\dot{N}O_2$ (I). As the compound may also be produced from nitric oxide and a solution of nitronium ion, one might also consider representing it thus: $\dot{N}O\,\overset{+}{N}O_2$ (II). Actually, its spectral properties indicate that it has an intermediate constitution, but one which much more closely resembles structure I than II. Thus the high vibration frequency (2,240 cm.$^{-1}$), depending on the multiple link in the NO-component of the complex, is displaced only one-seventh of the way from the frequency of the nitrosonium ion (2,300 cm.$^{-1}$) towards the frequency of nitric oxide (1,880 cm.$^{-1}$).

We regard the components of this compound ion as being held together by a one-electron bond, that is, by the reversible electron-transfer which would interconvert structures I and II. It is reasonable that structure I should make a considerably larger contribution than II to the wave-function of the mesomeric complex $\overset{+}{NO},NO_2$; for the oxidation-levels of the components of I (which may be denoted by the nitrogen-oxidation numbers 3 and 4) are not as widely separated as are the oxidation-levels of the components of II (the oxidation numbers of which are 2 and 5). Therefore structure I should have a smaller tendency to pass by a redox electron-transfer into II, than II should have to pass into I; that is, the mesomeric state will more closely resemble I.

This case may help to clarify the position of Weiss's univalent electron-transfer theory of molecular compounds[2], some critics of which forget that (as Weiss implies, but does not emphasize) electron-transfers are in principle always reversible[3]. A practically irreversible one-electron transfer to form an ionic bond, as in a Wurster salt, to the normal state of which the structure $\overset{+}{B}\dot{A}$ contributes everything, and $B\dot{A}$ nothing, and a perfectly balanced transfer to give a fully homopolar one-electron bond, as in the hydrogen molecule-ion, to which the structures $\overset{+}{H}\,\dot{H}$ and $\dot{H}\,\overset{+}{H}$ make equal contributions, evidently constitutes limiting cases of a more general picture of compound formation by one-electron bonds varying in type from fully homopolar to fully electrostatic. Our ion $N_2O_3^+$ belongs to the general case of a partly homopolar and partly electrostatic bond: structure I contributes much more than II, but not everything. If we consider $N_2O_3^+$ to be produced from NO and NO_2^+, we may approximately describe it as having been formed through a Weiss transfer; whereas, if we think of it as derived from NO^+ and NO_2, then our first approximate description might well be that the binding arises from the incursion of exchange.

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Nov. 23.

[1] By Goulden and Millen, probably in *J. Chem. Soc.*
[2] *Nature*, 147, 512 (1941); *Trans. Farad. Soc.*, **37**, 780 (1941); *J. Chem. Soc.*, 245 (1942); 462 (1943).
[3] Cf. Bateman, Hughes and Ingold, *J. Chem. Soc.*, 243 (1944).

Preparation of High Specific Activity Hydrogen Sulphide (H_2S^{35}) from Neutron-Irradiated Potassium Chloride

The recent note of U. Croatto and A. G. Maddock[1] pointing out the desirability of producing radio sulphur in its lowest, rather than in its highest, valency form, as it ordinarily occurs when potassium chloride is irradiated with slow neutrons, has prompted us to comment on the method used in this laboratory for producing H_2S^{35} from neutron-irradiated potassium chloride.

Neutron-irradiated potassium chloride was put in a quartz container which was first evacuated and then sealed with about 25 cm. of hydrogen in it. This container was heated to 1,100° C. for three hours and then permitted to stand overnight at 550° C. Chemical examination of both the gas and solid phase showed that more than 95 per cent of the sulphur activity which was originally present in the solid phase was now in the gas phase and all of it was in the form of hydrogen sulphide.

It might be appropriate to comment at this time on the other aspect of the letter by U. Croatto and A. G. Maddock, namely, that of the state of oxidation of the sulphur formed from the reaction $Cl^{35}(n,p)S^{35}$. We have found that if the pre-irradiation treatment of the potassium chloride is sufficiently drastic, one can alter, at least in part, the oxidation state of the radiosulphur produced[2]. Recently, we subjected a group of potassium chloride crystals of various sizes to an outgassing procedure which consisted of heating to 700° C., pumping with a diffusion pump for 72 hr. and then irradiating the crystals in an atmosphere of hydrogen in the Oak Ridge pile. Chemical examination showed that the smallest crystals had about 40 per cent of their sulphur activity in the − 2 state and 60 per cent in the + 6 state. The fraction of activity in the hexavalent

state was a function of crystal size and ranged from 60 to 95 per cent when the crystal size varied from a few tenths of a millimetre to three millimetres on edge. The crystals were approximately cubic in shape. This type of observation has led us to conclude that the hexavalent state of the radiosulphur that normally occurs in neutron-irradiated potassium chloride is due in part at least to oxidation by oxygen that has been occluded in the crystals. At first sight this type of argument seems to be incompatible with the observation on rubidium chloride[1]; however, it should be pointed out that if the above picture is correct, the chemical state of the sulphur should be dependent on the prior history of the crystals. If the crystals were made in such a way that oxidizing materials were excluded, then one might expect to find the sulphur in the − 2 state.

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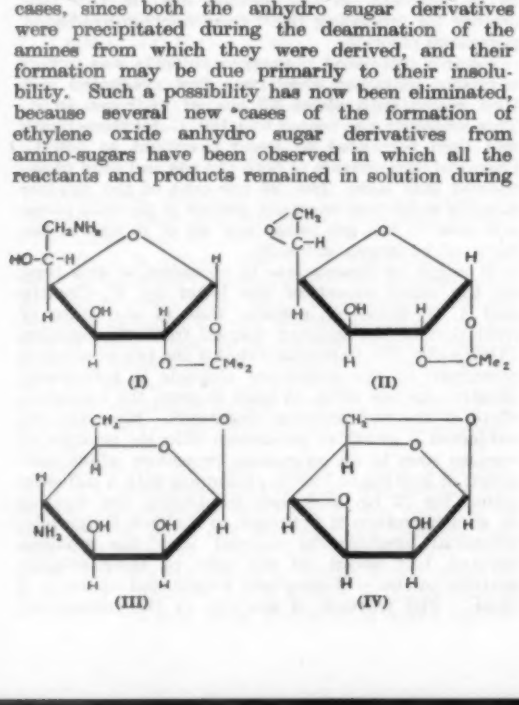
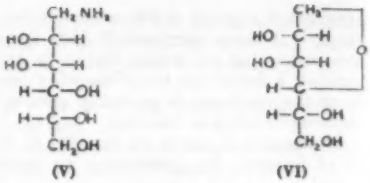
[1] Croatto, U., and Maddock, A. G., *Nature*, **164**, 613 (1949).
[2] Koski, W. S., *J. Amer. Chem. Soc.*, **71**, 4042 (1949).

Deamination of Certain Amino Derivatives of Sugars and Sugar Alcohols

It has already been observed[1] that the deamination of certain amino-sugar derivatives leads to the formation of ethylene oxide anhydro sugars. Thus, when 2-amino 4 : 6-benzylidene α-methyl-2-deoxyaltroside was treated with nitrous acid in acetic acid solution, deamination proceeded rapidly and smoothly and 2 : 3-anhydro 4 : 6-benzylidene α-methylalloside was precipitated. Similarly, the relatively insoluble 2 : 3-anhydro 4 : 6-benzylidene α-methylmannoside was obtained when 3-amino 4 : 6-benzylidene α-methyl-3-deoxyaltroside was deaminated. It might be argued that these two examples are exceptional cases, since both the anhydro sugar derivatives were precipitated during the deamination of the amines from which they were derived, and their formation may be due primarily to their insolubility. Such a possibility has now been eliminated, because several new cases of the formation of ethylene oxide anhydro sugar derivatives from amino-sugars have been observed in which all the reactants and products remained in solution during the reaction. Thus, deamination of 6-amino 1 : 2-*iso*propylidene 6-deoxyglucose (I) in acetic acid solution gives 5 : 6-anhydro-1 : 2-*iso*propylidene glucose (II), and that of 4-amino 1 : 6-anhydro 4-deoxy-β-D-mannose[2] (III) under similar conditions furnishes 1 : 6-3 : 4-dianhydro-β-D-talose (IV). In this case the deamination is accompanied by Walden inversion at C_4.



(I) (II) (III) (IV)



(V) (VI)

Experiments on the deamination of carbohydrate amino-derivatives have also been extended to the sugar alcohol series. Thus 1-amino-1-deoxysorbitol was shown to give rise to 1 : 4-anhydrosorbitol by Bashford and Wiggins[3], and now the deamination of 1-amino-1-deoxymannitol (V) has been carried out and found to result in the formation of 1 : 4-anhydromannitol (VI). Studies on the deamination of the 2-amino-2-deoxysorbitol, obtained by the catalytic hydrogenation of glucosamine, have been commenced. An anhydrohexitol, isolated as its tetra-acetate, was obtained (found: C, 50·6; H, 5·9; OAc, 51·6. $C_{14}H_{20}O_9$ requires C, 50·6; H, 6·0; OAc, 51·8 per cent). This, by analogy with the work of Levene[4] on the deamination of 2-aminohexosaminic acids, is most probably a 2 : 5-anhydrohexitol which, if Walden inversion accompanies the deamination, will be 2 : 5-anhydromannitol, or if no such inversion of configuration occurs at C_2, will be 2 : 5-anhydrosorbitol. Efforts are being made to decide this question.

We are grateful to the Colonial Products Research Council for its support during this investigation.

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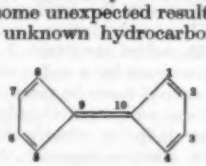
[1] Wiggins, L. F., *Nature*, **157** 300 (1946).
[2] James, Mrs. S. P., Smith, F., Stacey, M., and Wiggins, L. F., *J. Chem. Soc.*, 625 (1946).
[3] Bashford, V. G., and Wiggins, L. F., *J. Chem. Soc.*, 299 (1948).
[4] Levene, P. A., "Hexosamines and Mucoproteins" (Longmans, Green and Co., Ltd., 1925).

Fulvalene

In a recent paper[1] dealing with the theoretical treatment of the chemistry of some non-benzenoid hydrocarbons, some unexpected results were obtained for the as yet unknown hydrocarbon fulvalene (I).



I

The π-electron densities, q, of fulvalene have been computed[2], and it is found that position 2 has a lower charge than position 1. In spite of this the calculated atomic polarization energies[1], A'_n, which may be considered to be approximations to the relative activa-

tion energies for nucleophilic substitutions, require position 1 to be the more reactive in this type of reaction. This anomaly is understandable if the self-atom polarizability[3], π, of position 1 is sufficiently greater than that of position 2. The polarizabilities have now been calculated and are compared with the π-electron densities and atomic polarization energies in Table 1. It must be concluded that the difference

Table 1. Self-atom polarizabilities

Position	$\pi(1/\beta)$	A'_n (k.cal.)	q
1	0·608	28·5	1·097
2	0·599	30·5	0·976

in polarizabilities is sufficient to cause the apparent discordance between A'_n and q, and so it is likely that fulvalene will prove to be the first example of a molecule in which the static charge distribution does not provide an adequate picture of the chemical reactivity.

The second unexpected result for fulvalene[1] is that the bond orders[4], p, and bond-localization energies[5], B', predict the opposite relative reactivities of bonds 2 : 3 and 9 : 10. From the classical bond diagram (I) and from the calculated mobile orders[3] it would be anticipated that the 9 : 10 bond is the more reactive. However, the bond-localization energy results[1] indicate that the 2 : 3 bond is the more reactive. Again these facts can be reconciled if the self-bond polarizability[3] of the 2 : 3 linkage is sufficiently greater than that of the 9 : 10 bond. Calculations of these polarizabilities indicate that this is so (Table 2).

Table 2. Self-bond polarizabilities

Bond	$\pi(1/\beta)$	B' (k.cal.)	p
2 : 3	0·509	21	0·448
9 : 10	0·191	29	0·390

Thus fulvalene is also likely to be unusual in that the classical bond diagram (I), or even the quantum mechanical static-bond orders, do not correctly reflect the reactivity for reactions such as ozonolysis.

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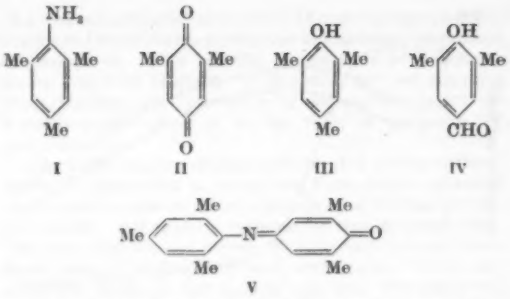
Nov. 21.

[1] Brown, *Trans. Farad. Soc.* (In the press).
[2] Brown, *Trans. Farad. Soc.*, **45**, 296 (1949).
[3] Coulson and Longuet-Higgins, *Proc. Roy. Soc.*, A, **191**, 39 (1947).
[4] Coulson, *Proc. Roy. Soc.*, A, **169**, 413 (1939).
[5] Brown, *Aust. J. Sci. Res.*, A (in the press).

Enzymatic Oxidation of $-CH_3$ to $-CHO$

We have previously shown[1] that peroxidase, together with hydrogen peroxide, will oxidize mesidine (I) to the purple crystalline compound 2 : 6-dimethylbenzoquinone-4-(2′ : 4′ : 6′-trimethyl) anil (V) in 95 per cent yield. When ferrous iron was substituted for the enzyme, the product was mainly ill-defined amorphous material. This enzymatic oxidation involves the elimination of a methyl group, and at the time we postulated the intermediate formation of 2 : 6-dimethylbenzoquinone (II) to explain the reaction. More recently we have shown[2] that the peroxidase system will oxidize 4-methoxy-2 : 6-dimethylaniline with the facile elimination of a methoxyl group (detected as methyl alcohol). *p*-Anisidine is also oxidized[3], with the elimination of a methoxyl group, to 2-amino-5-*p*-anisidinobenzoquinone-*bis*-*p*-anisylimine and tetra-*p*-methoxy azophenine.



We have now investigated the peroxidase oxidation of mesitol (III), and have so far isolated two products in a pure condition, namely, 4-hydroxy-3 : 5-dimethylbenzaldehyde (IV) and the quinone (II). Moreover, the aldehyde is oxidized by the further action of the peroxidase system to II.

It is believed that the oxidation of III to IV constitutes the first recorded peroxidase oxidation of a $\cdot CH_3$ group to a $\cdot CHO$ group. Experiments with ferrous iron in place of the enzyme are in progress.

Experimental details and suggestions for the mechanism of the peroxidase oxidation will be published elsewhere later.

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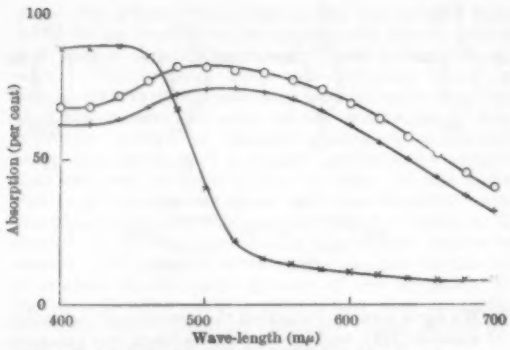
[1] Chapman, N. B., and Saunders, B. C., *J. Chem. Soc.*, 496 (1941).
[2] Saunders, B. C., and Watson, G. H. R., *Biochem. J.* (In the press).
[3] Daniels, D. G. H., and Saunders, B. C. (to be published).

A Colour Reaction Applicable to the Pyrethrins

Hestrin[1] has described the analytical application of a reaction between carboxylic acid derivatives and hydroxylamine. The reaction product gives a coloured complex with ferric chloride in acid solution. This reaction takes place with the pyrethrins and their synthetic analogues, and coloured complexes are formed with ferric chloride.

The experimental procedure, which was very similar to that used by Hestrin, was as follows. 6 ml. of alkaline hydroxylamine reagent (3 ml. 2 *M* hydroxylamine hydrochloride solution and 3 ml. 3·5 *N* sodium hydroxide solution) was added to 3 ml. of an ethanolic solution of ester and the mixture allowed to stand for one minute or more. The solution was then acidified with 3 ml. of hydrochloric acid (1 vol. concentrated hydrochloric acid sp.gr. 1·18 + 2 vol. of water), and finally 3 ml. of ferric chloride solution (0·37 *M* in 0·1 *N* hydrochloric acid) was added. Absorption measurements were made with a 'Unicam' diffraction grating spectrophotometer (Model *S.P.*350). It is important that a blank should be carried out with the ethanol alone, to ensure the absence of impurities giving a coloured complex.

The absorption spectra of the complexes obtained from a mixture of the natural pyrethrins, purified by the nitromethane technique[2], and the synthetic pyrethrin analogue, the DL-*cis*-*trans* chrysanthemum monocarboxylic acid ester of 3-methyl-2-allyl-*cyclo*-penten-4-ol-1-one (see graph), are closely similar to that described by Hestrin[1].



Absorption spectra of coloured pyrethrin complexes: ×—×—, blank; O—O—, synthetic pyrethrin I analogue (colour from 7·4 mgm.); +—+—, natural pyrethrin mixture, Py I : Py II = 1·6 : 1·0 (colour from 1·8 mgm.). These last two are corrected for absorption of blank

The absorption, log (I_0/I), by the coloured complexes at λ 540 mμ is proportional to the amount of ester used, and to this extent the reaction is quantitative; but as is to be expected from the results of Hestrin[1], it is also dependent upon the acidic and alcoholic components of the ester. Thus, to give the same colour intensity, the amount of the synthetic pyrethrin analogue required is 3·3 times that of the natural pyrethrin mixture (pyrethrin I : pyrethrin II = 1·6 : 1). Since the naturally occurring esters of chrysanthemum dicarboxylic acid (so-called pyrethrin II) contain two ester groupings, they may be expected to yield a more intense coloration than the esters of chrysanthemum monocarboxylic acid (so-called pyrethrin I), which is in line with the experimental results.

It is clear, therefore, that the reaction cannot be applied to the estimation of the 'pyrethrins' unless: (1) they can be first separated; or (2) the ratio in which the 'pyrethrins' occur is known to be constant. Nevertheless, the colour reaction should prove to be useful for the detection of the pyrethrins in any attempt to separate them by chromatographic methods.

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[1] Hestrin, S., *J. Biol. Chem.*, **180**, 249 (1949).
[2] Barthel, W. F., Haller, H. L., and LaForge, F. B., *Soap*, 65 (1944).

Ion Exchange Resin Membranes and Resin-Impregnated Filter Paper

Marshall[1] has prepared zeolite membranes and has used them as electrodes for the determination of ionic activities in solution in a manner analogous to the use of the glass electrode for the measurement of hydrogen ion activities. It is a logical step to attempt to use ion exchange resins in the form of membranes for similar purposes. However, the difficulties of preparing these are considerable.

These difficulties have been overcome, and we have prepared ion exchange resins in the form of membranes, rods, tubes and thimbles, containing SO_3H-, COOH- or amino- (both strongly and weakly basic) groups, and which are mechanically stable and free from cracks. A full account of the method of preparation will be published elsewhere.

The membranes consist of cross-linked resin polymers of identical composition to the well-known granular ion exchange resins and are insoluble in all aqueous and non-aqueous liquids. They are hydrated and, like the fully wetted granules, contain approximately 55 per cent of their own weight of water. The SO_3H- and COOH-resins can be converted to any desired cationic form by treating them with an excess of a solution of a salt of the appropriate cation. Similarly, anion exchange resin membranes can be converted to any desired form by treating them with the appropriate acid or base.

It is somewhat difficult to mount the membranes for use. They cannot be cemented, for example, to a glass tube as Marshall did with his zeolite membranes, since it is difficult to find a cement which will adhere to both the wet resin surface and the dry glass surface. However, the use of a resorcinol-formaldehyde resin shows promise as a cement. Modified membranes have been prepared in which difficulties of mounting are completely overcome. The membrane is formed within the pores of a sintered glass disk suitably mounted in glass, or within the pores of a paper Soxhlet thimble. Similarly, filter paper can be impregnated with the resins.

The electrical resistance of the unsupported membranes is low, and the specific resistance of a typical membrane containing sulphonic groups and in the hydrogen form is 33·2 ohms per c.c. The resistance of the supported membranes is slightly higher, depending upon the shape, but still comparatively low. The total ionic capacities of the membranes containing sulphonic and carboxyl groups are of the order of 1·5 m.eq. per (wet) gm., and those of the anion exchange membranes about 5 m.eq. per gm.

Preliminary studies indicate that the sulphonic membranes give steady and reproducible E.M.F.s in cells of the type

Sat. calomel | M^+ (a_1) || membrane || $M^+(a_2)$ | sat. calomel.

The resins are stable in organic solvents and we have used them to measure activities in non-aqueous solutions such as alcohol and acetone. Some resins are permeable to large organic cations[2] and can be employed for the measurements of the activities of these ions in solution.

Other resins have somewhat smaller pores, and membranes prepared from them show ionic 'sieve' effects. Electrodialysis through such resin membranes of a solution containing large and small ions indicates that in favourable cases separations can be achieved.

Datta *et al.*[3] have recently prepared and used alumina-impregnated filter paper for chromatography, and, likewise, the known methods of filter paper chromatography can be employed with the resin-impregnated filter papers. In addition, differences in ionic mobility within the resin can be exploited to separate ions by passing an electric current between electrodes clamped to the ends of the paper.

The work is being continued, and it is hoped to publish more detailed accounts of it as it progresses.

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[1] Marshall *et al.*, *J. Amer. Chem. Soc.*, **63**, 1911 (1941); *J. Phys. Chem.*, **46**, 52 (1942); *J. Amer. Chem. Soc.*, **64**, 1814 (1942); *J. Phys. Chem.*, **48**, 67 (1944); *J. Amer. Chem. Soc.*, **70**, 1297 (1948), etc.
[2] Kressman and Kitchener, *J. Chem. Soc.*, 1208 (1949).
[3] Datta, Overell and Stack-Dunne, *Nature*, **164**, 673 (1949).

Aromatic Tanning in the Myriapod Cuticle

BROWN[1] has found that the precursor of the quinone responsible for the tanning of certain structures in *Mytilus* and of the egg capsule in *Fasciola* is probably an amino-acid or protein, in contrast to the alcohol-soluble phenol operative in the cockroach ootheca and the insect cuticle[2,3,4]. He suggests that the tanning mechanism may have evolved from a type where the phenolic hydroxyl groups of tyrosine become oxidized to the quinone without removal of the side-chains. It is therefore interesting to find, in myriapods, evidence which appears to indicate the retention of this suggested original mechanism of tanning.

A comparative study of the cuticle of various myriapods has clearly shown that the endocuticle subjacent to regions of extensive sclerotization differs considerably from the endocuticle of the arthrodial membranes, where sclerotization is slight. In the sclerites of *Lithobius forficatus*, where an appreciable outer thickness is tanned, the inner layer, although histologically similar to that of the arthrodial membrane, shows unexpected chemical properties. It is intensely positive to Millon's reagent and reduces ammoniacal silver nitrate, thus appearing to be rich in phenolic substances. A protein is probably involved, since the sclerite endocuticle has an iso-electric point in the region of *p*H 5, whereas that of the arthrodial membrane endocuticle is much lower (*p*H 2·8–3·0). The substance responsible for this higher iso-electric point does not dissolve in water or alcohol, and treatment of the cuticle with diaphanol does not remove the difference between the two regions of endocuticle as would be expected if due to a free phenol. In *Haplophilus subterraneus* the inner part of the exocuticle is colourless and yet is different from the endocuticle in being optically homogeneous and refractile. This is an optical appearance of the substance, which, in the endocuticle of *Lithobius*, betrays its presence only on certain chemical tests being applied. The foregoing observations suggest that there is a precursor of sclerotin in which is not water- or alcohol-soluble. This substance has accordingly been termed pro-sclerotin.

These facts also suggest that, in a myriapod, the protein precursor of sclerotin and the phenolic substance responsible for its becoming tanned are possibly the same substance, pro-sclerotin. It seems possible that tyrosine is the unit of this self-tanning protein, and, indeed, it has an iso-electric point similar to that of pro-sclerotin. Observations of other workers are not inconsistent with these views. Browning[5] records an iso-electric point of the endocuticle of *Tegenaria* of *p*H 5·0–5·5, similar to that of *Lithobius*. These figures are very different from those for the endocuticle of *Sarcophaga* larvæ[6] and the chitin (endocuticle) of the foregut of *Homarus*[7], both of which have unhardened cuticles; but I have determined the iso-electric point of the endocuticle of *Calliphora* after formation of the puparium and found it to be in the region of *p*H 5 and not *p*H 3 as might have been expected.

The epicuticle of *Sarcophaga* larvæ[6] and the 'cuticle' (epicuticle) of the foregut of *Homarus*[7] have iso-electric points higher than those of the inner layers, again in the region of *p*H 5. The outer layers in these two cases appear to be related to pro-sclerotin, and their chemistry and staining reaction confirm this view. Dennell[6] records the fact that the junction of the endocuticle and exocuticle of *Sarcophaga* puparia stains red with Mallory, like the unhardened epicuticle of the larva. The sclerite endocuticle of *Lithobius* stains red with Mallory. It appears that red-staining with Mallory and elevation of iso-electric point go hand-in-hand—that it is, in fact, a property of pro-sclerotin.

The outer layers of *Sarcophaga* and *Homarus* are, however, described as being free from chitin, whereas there is no evidence in myriapods of a similar chitin-free layer. All regions respond to the chitosan test. The two histological layers of a myriapod have thus been termed endocuticle and exocuticle. They are optically distinct, but merge one into the other by way of pro-sclerotin. Most differences in the myriapod cuticle can apparently be explained by regarding it as a chitinous matrix impregnated to varying extents by pro-sclerotin which may or may not be tanned.

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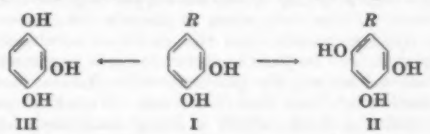
[1] Brown, C. H., *Nature*, **165**, 275 (1950).
[2] Pryor, M. G. M., *Proc. Roy. Soc.*, B, **128**, 378 (1940).
[3] Pryor, M. G. M., *Proc. Roy. Soc.*, B, **128**, 393 (1940).
[4] Pryor, M. G. M., Russell, P. B., and Todd, A. R., *Biochem. J.*, **40**, 627 (1946).
[5] Browning, H. C., *Proc. Roy. Soc.*, B, **121**, 65 (1942).
[6] Dennell, R., *Proc. Roy. Soc.*, B, **133**, 348 (1946).
[7] Yonge, C. M., *Proc. Roy. Soc.*, B, **111**, 298 (1932).

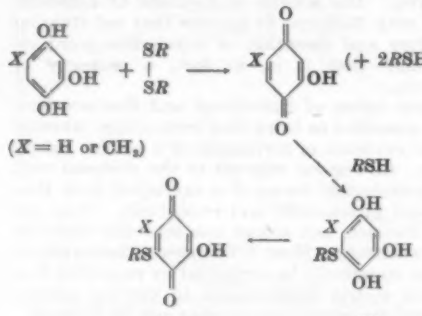
Quinone Tanning in the Animal Kingdom

THE communication under the above title by Brown[1] prompts us to record that we have been engaged on the same problem from the chemical point of view during the past few years. Our approach was based on the assumption that *combined* tyrosine (in a protein) could be oxidized to *combined* 3 : 4-dihydroxyphenylalanine (I) [$R = CH_2.CH(NH.CO.R').CO.NH.R'$, where R' is part of the protein residue], which might then undergo oxidation in either of two ways, namely: (i) direct hydroxylation of the benzene nucleus in the 6-position to give (II), (ii) oxidative elimination of R to produce hydroxyquinol (1 : 2 : 4-trihydroxybenzene) (III). In either case, a 1 : 2 : 4-trihydroxybenzene derivative would be produced.

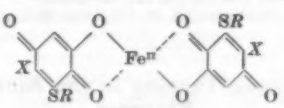


From our point of view, the combined amino-acid side-chain of (II) is of relatively little importance, since ring closure of such a compound to an indole derivative[2] can no longer occur. The simplest and most readily accessible prototype of (II) is clearly 2 : 4 : 5-trihydroxytoluene, which is readily prepared, as its triacetate, by the Thiele acetylation[3] of toluquinone. Hydroxyquinol is similarly available, starting from benzoquinone. When dilute aqueous solutions of either of these trihydroxy-compounds are applied to human skin, there develops during eight to twenty-four hours a brownish-black stain. We are of the opinion that the trihydroxy-compounds, functioning as reducing agents, convert some of the S.S bonds of the keratinous protein into .SH groups, which then react with the hydroxyquinone produced

to give a thio-compound (as IV). This could then undergo oxidation to the thio-quinone (V), which



might also add the second *R*SH in the manner indicated. In either case, the quinone molecule would be incorporated into the protein chain. The colour of the stains, however, appeared to us to be too black for a quinonoid structure of the above type, and we surmised that iron present in the skin[4] or in the blood supply to the skin was being incorporated into the final structure to give a co-ordinated iron



complex of the type (VI) (an Fe^{III} complex is, of course, not excluded). Our subsequent work with wool indicates that this is probably the correct explanation, although the over-all reactions may not be so simple as we have suggested. Thus, wool can be dyed various shades of brown by aqueous solutions of the two trihydroxy-compounds. Simultaneous treatment with various metal salts (for example, ferrous, cupric, cobalt) causes a marked darkening in the shade, which becomes almost black when ferrous iron is used. The above process on living skin can thus be separated into two distinct stages with wool.

The experimental evidence supporting the incorporation of the colourless triphenols into wool to give dyed materials, and the mode of combination suggested, will be presented shortly in a paper which we are submitting for publication in the *Journal of the Society of Dyers and Colourists*. We would point out that the work, which is being continued, has a direct bearing on (*a*) the oxidative dyeing of keratinous proteins, and (*b*) the production of pigments (other than melanins) in both the animal and vegetable kingdoms.

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[1] Brown, *Nature*, **165**, 275 (1950).
[2] Compare Raper, *Biochem. J.*, 21, 89 (1927).
[3] Thiele and Winter, *Annalen*, **311**, 341 (1900).
[4] Compare Mitchell and Hamilton, *J. Biol. Chem.*, **178**, 345 (1949).

Quinone Tanning in the Cocoon-Shell of *Dendrocœlum lacteum*

Dr. C. H. Brown, in her letter in *Nature* of February 17, suggests that the 'winter egg case' (cocoon-shell) of planarians may be a tanned protein. Vialli[1,2] has shown that the vitelline cells of *Distomum hepaticum* and *Dendrocœlum lacteum* contain a substance in which there is a di- or poly-phenol. Later, Stevenson[3] showed that the egg-shell of *Distomum hepaticum* is composed of a quinone-tanned protein, similar to the sclerotin of the cockroach ootheca[4], and derived from the granules or globules in the vitelline cells. During my investigation of cocoon formation in *Dendrocœlum lacteum*, I have found that the cocoon-shell, as in Trematodes, has the phenolic precursor in the globules of the vitelline cells. Evidence for this arises from histochemical tests carried out on sections of whole animals and of both tanned and untanned cocoon-shells. Both the globules in the vitelline cells and the untanned shell of a forming cocoon show a positive reaction to the argentaffine test[5], and also show definite green coloration when tested with ferric chloride; this changes to pink on the addition of sodium carbonate, indicating the presence of an *o*-dihydroxyphenol. Standard protein tests carried out on the cocoon-shell were also positive. The origin of the protein present in the cocoon-shell and of the oxidase necessary to produce quinone from phenol is now being investigated.

It is hoped to publish a further account of cocoon formation in planarians later.

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[1] Vialli, M., *Boll. Zool.* (*Naples*), **4**, 135 (1933).
[2] Vialli, M., *Boll. Zool.* (*Turin*), **5**, 21 (1934).
[3] Stevenson, W., *Parasit.*, **38**, 128 (1947–48).
[4] Pryor, M. C. M., *Proc. Roy. Soc.*, B, **128**, 378 (1940).
[5] Lison, L., "Histochimie Animale" (Paris, 1936).

Weed Control in Root Crops by Pre-sowing Applications of *iso*-Propylphenylcarbamate and Mixtures of that Substance and 'Methoxone' or 2,4-Dichlorophenoxyacetic Acid

Preliminary trials during the past two years, which aimed at replacing costly cultivations in root crops by chemical methods of weed control, have now been completed at Jealott's Hill. *iso*-Propylphenylcarbamate, 'Methoxone' (2,methyl-4,chlorophenoxyacetic acid) and 2,4-dichlorophenoxyacetic acid were known to prevent the germination of certain plant species when applied as pre-emergence dressings[1,2], and the species response to *iso*-propylphenylcarbamate was different from that of the other two compounds. Therefore, mixtures of *iso*-propylphenylcarbamate with 'Methoxone' and with 2,4-dichlorophenoxyacetic acid were examined alongside pre-emergence dressings of the individual components.

In both years the compounds were applied by hand, intimately mixed with 2 cwt. of fine china clay per acre to ensure even distribution. The *iso*-propylphenylcarbamate used was practically pure, the 'Methoxone' contained 46 per cent 'Methoxone' acid, some of which was present as sodium salt, and the 2,4-dichloro-

phenoxyacetic acid contained 96 per cent of the sodium salt. All rates of application below refer to lb./acre of active principle (that is, the pure ester for the first compound and the pure acids for the other two).

The applications were made at different intervals (0–8 weeks) prior to crop sowing, and these were followed by observations on subsequent crop-growth and weed-control. The main experiments were on kale and mangolds; but lettuce, onions, field beans, peas, lucerne, sugar beet and swedes were included in the second year.

The results can be summarized as follows:

WEEDS

m-Propylphenylcarbamate (1) alone: At 2½ and 5 lb./acre, good control of grasses and *Polygonum* spp. was achieved.

'Methoxone' (2) alone; 2,4-Dichlorophenoxyacetic acid (3) alone: The two compounds were very similar in effect. 1-2 lb./acre prevented the emergence of a range of weed species.

1 and 2; 1 and 3: Mixtures of (1) at 5 lb./acre and (2) or (3) at 1 lb./acre gave excellent weed control, each acting upon the weed species susceptible to it. Against chickweed (*Stellaria media*) and cleavers (*Galium aparine*), the mixture was better than either component alone.

In general, the weed-killers were more effective when applied prior to the emergence of the weed seedlings and when there was the least possible subsequent disturbance of the surface soil.

CROPS

(1) alone: 5 lb./acre was without effect on kale, mangolds, lettuce, onions, beans, peas, lucerne, sugar beet and swedes even when applied as late as two weeks prior to sowing.

(2) alone; (3) alone: The minimum safe period between application and seed sowing for most of the above crops when the dose was 1 lb./acre was three to four weeks. Heavier doses required longer periods.

(1) and (2); (1) and (3): Mixtures of (1) at 5 lb./acre and (2) or (3) at 1 lb./acre gave results on the crops very similar to those of (2) or (3) alone at 1 lb./acre.

The preliminary trials summarized in this communication are being extended to cover a range of soil and climatic conditions; but, although the conclusions are only tentative, they point to new possibilities of weed control in crops where at present few chemical methods are available. Full publication will be made when adequate conclusive evidence has been obtained.

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[1] Templeman, W. G., and Sexton, W. A., *Proc. Roy. Soc.*, B, **133**, 300 (1946).
[2] Templeman, W. G., and Sexton, W. A., *Proc. Roy. Soc.*, B, **133**, 480 (1946).

Nitrate Accumulation in Uganda Soils

In preliminary work[1] evidence has been obtained of the accumulation of notable quantities of nitrate nitrogen on a bare soil. Under a grass mulch this effect is not shown; in fact, an initially high nitrate status is depressed by the application of a grass mulch. Both the rise in nitrate content on a bare soil and the fall under a mulch take place on the onset of rains. A soil newly opened from grass has a low nitrate status[2] and there is a time-lag of several weeks before a build-up of nitrate occurs.

These results were obtained at the main research station at Kawanda on a soil with a *p*H of 6·3 under an annual bi-modal rainfall of a little more than 40 in. Similar results are now being obtained on a soil of *p*H 5·0 under the same rainfall conditions and on a soil, in the eastern province of Uganda, of *p*H 6·0 with a rainfall of about 54 in. (bi-modal). We are therefore encouraged to believe that the phenomena described may be of wide occurrence, at least throughout East African conditions.

The quantities of nitrate built up are considerable; seasonal figures of 500 p.p.m. have been recorded, and a figure of 200 p.p.m. seems to be not unusual. It is thought that the development of such high amounts of nitrate, apart from their agricultural significance, which may be considerable, may also be important pedologically and have a bearing on soil-forming processes under these conditions.

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[1] ap Griffith, G., and Manning, H. L., *Trop. Agric.* (in the press).
[2] ap Griffith, G., *E. African Agric. J.*, **14**, No. 4, 187.

Elastic Properties of Ox Synovial Fluid

The viscosity of synovial fluid varies with the shear stress, and there is evidence that the liquid contains elongated particles of a complex of hyaluronic acid and protein[1]. It therefore seemed reasonable to inquire whether synovial fluid, like certain solutions of linear polymers[2,3,4], might also show shear elasticity. Some information on this aspect of its rheological behaviour has now been obtained with a co-axial cylinder elastoviscometer which will be described elsewhere by two of us (B. A. T. and D. J. S.) in collaboration with J. G. Oldroyd.

The tests were made at 25° C. on a pooled sample of ox synovial fluid: this contained 0·08 gm. of hyaluronic acid/100 ml., and its relative viscosity (measured at 25° C. in an Ostwald viscometer of 2 ml. capacity and water-time 12 sec.) was 16·8. The results of two experiments with the elastoviscometer, though not readily interpretable quantitatively, showed that the behaviour of this liquid when subjected to periodic stresses was similar to that of certain dilute poly(methyl methacrylate) solutions (for example, a mixture of 'Perspex' and *n*-butyl acetate containing 1·5 gm. of polymer/100 ml.). Since there is reason to attribute the observed behaviour of these latter materials to shear elasticity, we conclude that synovial fluid also shows this property.

It seems possible that the shear elasticity of synovial fluid may be of significance with regard to its function in joints. Thus, the fluid will yield less under stress rapidly applied than if it were a merely viscous liquid, and this might serve to protect the synovial membranes when a sudden stress is applied to the joint.

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[1] Ogston and Stanier, *Biochem. J.* (in the press).
[2] Philippoff, *Phys. Z.*, **35**, 834, 900 (1934).
[3] van Wazer and Goldberg, *J. App. Phys.*, **18**, 207 (1947).
[4] Smith, Ferry and Schremp, *J. App. Phys.*, **20**, 144 (1949).

Relation of Vitamin E to Intestinal Flora and the Intestinal Absorption of Tocopherol

RECENTLY, J. J. Pindborg[1] reported that bacterial synthesis of vitamin E takes place in the digestive tract of the rat; and he might have cited experiments by Daft *et al.*[2] as presumptive confirmation. In both laboratories, rats which were subjected to sulpha drug-feeding to inhibit the activity of intestinal flora developed symptoms characteristic of vitamin E deficiency—muscle degeneration in Daft's laboratory and incisor teeth abnormalities and depigmentation in Pindborg's. If, however, extra vitamin E were administered, the deficiency syndromes did not develop. Pindborg suggested that intestinal micro-organisms had been synthesizing tocopherol, in amounts sufficient to meet the animals' needs, prior to the addition of sulpha drugs to the diet; afterwards, synthetic activity of the intestinal flora was diminished by the sulpha compounds, insufficient tocopherol was present in the intestinal tract, and vitamin E deficiency developed unless extra quantities of vitamin E were given as supplements.

We prefer a simpler explanation. Perhaps sulpha drugs, at a 1 per cent level in the diet, merely increase the vitamin E requirement of rats, as do many other dietary and environmental factors[3–5].

Pindborg also cited the positive results of a vitamin E bioassay of fæces from normal rats maintained on a good stock ration as definite direct evidence of vitamin E synthesis in the intestinal tract.

Again we prefer the simple explanation that any vitamin E present in fæces merely represents dietary tocopherols which have passed through the gastro-intestinal tract unabsorbed. Cuthbertson and associates[6], Engel and Heins[7], and Hines and Mattill[8] have already reported that tocopherol-like materials, measured by chemical and spectrographic procedures, are present in the fæces of rats receiving diets rich in vitamin E and are absent in excreta of animals maintained on vitamin E-low diets. We have confirmed these findings in our Laboratories and, in addition, have obtained the following relevant results.

Fæcal excretion of tocopherol-like reducing substances is proportional to the amount of tocopherols fed within wide limits (1–100 mgm. of tocopherols daily). Age of the animal is apparently not a factor in determining the extent of intestinal wastage of large doses of vitamin E, because experiments have been conducted on weanling rats, young fully grown adult rats, and senile rats, with almost identical results. The type of α-tocopherol fed, whether synthetic racemic or natural *d*-form, is apparently immaterial, while adjuvants such as bile salts and lecithin fed with the vitamin E are effective in increasing absorption of vitamin E.

Humans are similar to rats in their inability to absorb completely orally administered tocopherols. Two adult males were studied, and fæcal excretion of tocopherols was determined during metabolic periods of nine to sixteen days, with and without vitamin E supplementation.

Vitamin E-deficient rats waste somewhat less supplementary vitamin E than do normal adequately nourished rats, presumably because their tissues are avid for tocopherol, resulting in more efficient intestinal absorption. The tocopherol-like substances excreted during supplementation with vitamin E have physiological potency. They are, in part at least, unchanged tocopherols, because vitamin E bioassays of lipid extracts of fæces from both supplemented rats and humans have been positive.

α-Tocopherol labelled with radioactive carbon has been fed to rats and traced through the body and the gastro-intestinal tract. The results will be reported in detail later; but preliminary findings indicate that some actual labelled-tocopherol, ingested in doses of physiological size (1 mgm. per day), is excreted in the fæces.

We conclude from these findings that the explanation for vitamin E activity in fæces is due, not to bacterial synthesis in the intestinal tract, but to failure of complete intestinal absorption of dietary or supplementary tocopherols.

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[1] Pindborg, J. J., *Nature*, **164**, 493 (1949).
[2] Daft, F. S., Endicott, K. M., Ashburn, L. L., and Sebrell, W. H., *Proc. Soc. Exp. Biol Med.*, **53**, 130 (1943).
[3] Hove, E. L., *Ann. N.Y. Acad. Sci.*, **52**, 217 (1949).
[4] Schwarz, K., *Z. physiol. Chem.*, **283**, 186 (1948).
[5] Mason, K. E., and Filer, L. J., *J. Amer. Oil Chem. Soc.*, **24**, 240 (1947).
[6] Cuthbertson, W. F. J., Ridgeway, R. R., and Drummond, J. C., *Biochem. J.*, **34**, 34 (1940).
[7] Engel, C., and Heins, J., *Acta Brevia Neerland. Physiol., Pharmacol., Microbiol.*, **13**, 37 (1943).
[8] Hines, L. R., and Mattill, H. A., *J. Biol. Chem.*, **149**, 549 (1943).

Histochemical Study of Fat Deposits in Chronic Intoxication of the Dog by γ-Hexachlorocyclohexane

CHRONIC intoxication of dogs by the γ-isomer of hexachlorocyclohexane was induced by repeated intramuscular injections of 10–30 mgm. of this substance in 10 per cent oily solution per kgm body-weight, until a total dose of 130–475 mgm./kgm. was reached. The dogs died or were killed seven to forty-four days after the first injection. The intoxication resulted in abnormal intracellular deposits of fat in most tissues and organs.

These deposits are revealed by general fat stains, such as Sudan Black and Scharlach R., on frozen sections of formaldehyde-fixed material. We have studied, by the available histochemical methods, the composition of these fats in liver, striated muscle, nervous cells, kidney, uterus epithelium and histiocytes. The fat droplets have no colour of their own, which shows that they do not belong to the carotinoid and chromo-lipoid groups. They are isotropic in polarized light. The Liebermann reaction gives a negative result, enabling us to exclude the presence of cholesterol and cholesterides, at least in notable quantities, except in some extracellular deposits in the lumen of terminal collecting tubules of the kidneys. The absence of free cholesterol is confirmed by a negative Windaus digitonine reaction. The Smith–Dietrich reaction for lipins (phospho- and galacto-lipins) is slightly positive. The Smith Nile Blue reaction for triolein is strongly positive; some fat droplets are red and appear to be constituted exclusively of triolein, but most droplets are violet, suggesting that the fat deposits are a mixture of saturated and unsaturated glycerids and of lipins. Since it has been denied that Fischler's method has any real value, there is no histochemical reaction for fatty acids.

The Feulgen plasmal reaction is strongly positive in the kidney fat deposits, less so in other fat droplets. It is slightly positive even without previous treatment by mercuric chloride, and this is very apparent in the kidney. Part of the fatty aldehydes seems to pre-exist to the slight oxidation by mercuric chloride.

We conclude that the abnormal fat deposits in the cells due to chronic γ-hexachlorocyclohexane intoxication are formed by a mixture of saturated and unsaturated glycerids and of lipins, mostly in an easily oxidizable or an oxidized form. Our researches do not exclude the presence of free fatty acids.

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Purification and Crystallization of Q-Enzyme

Following the isolation by Hanes[1] of an enzyme from potato juice which catalyses the formation of amylose from glucose-1-phosphate, the discovery of a related enzyme, termed *Q*-enzyme, in potato juice was announced by Haworth, Peat and Bourne[2]. This enzyme converts amylose into amylopectin. An improved method of purification was described recently by Barker, Bourne and Peat[3]. We now wish to report a different method of preparation which leads to a crystalline product. Our method makes use of precipitation at low temperature with ethanol from solutions of low ionic strength, followed by crystallization from ammonium sulphate solution.

Peeled and sliced potatoes are steeped in 0·7 per cent sodium hydrosulphite solution for 20 min., washed in water and minced. The juice is then expressed, centrifuged and brought to a concentration of 11 per cent in ethanol at − 2° C. The precipitate is discarded and the ethanol concentration raised to 16 per cent at − 5° C. to give a further precipitate. This is taken up in sodium citrate solution of *p*H 6·0 and ionic strength 0·01, and the solution again brought to 11 per cent in ethanol. The slight precipitate is removed and the concentration of ethanol raised to 16 per cent, the *p*H and ionic strength being kept constant throughout. The precipitate is taken up in citrate solution and reprecipitated at 16 per cent ethanol. The final precipitate is dissolved in citrate solution and ammonium sulphate added at 0° C. to an ionic strength of 3·8 and *p*H of 6·2. The precipitate is dissolved in water, and ammonium sulphate is added at 10° C. until a cloudiness appears at an ionic strength of about 3·2. The solution is cleared by adding the minimum amount of water and then cooled slowly to 0° C. *Q*-enzyme separates in a few hours in needle-like crystals.

The quantity of material available has not permitted more than a provisional estimate of the absolute activity of the crystals. A solution of amylose of initial light absorption value[4] of 1·30 was half-converted into amylopectin in 12 min. (the light absorption value being used as a measure of the relative proportions of branched and linear molecules) at 20° C. in 0·2 *M* sodium citrate solution of *p*H 7·0 in a digest containing $2{\cdot}2 \times 10^{-3}$ mgm. of enzyme per ml. (protein determination by Kjeldahl using the factor 6·25 for converting nitrogen to protein). If the conversion of amylose to amylopectin is assumed to be unimolecular, this corresponds to a rate-constant of 2·7 $min.^{-1}$ per mgm. protein per ml. and to an activity for the enzyme of 2·7 in the units suggested in a previous paper[5].

After five hours, when the light absorption value of the solution above had fallen to 15 per cent of its initial value, no reducing power could be detected; but after 24 hr. when absorption was 11 per cent, the reducing power was equivalent to an apparent conversion of 2 per cent of the initial weight of amylose to maltose. The crystals were free from phosphorylase and amylose precipitant.

A rough estimate of the weight of *Q*-enzyme in the potatoes used for the extraction was made by comparing the activity of the purified enzyme with that of the potato juice after proceeding to the first 16 per cent ethanol precipitation to remove interfering amylose precipitants. It was found that 2·9 mgm. was present per kgm. of potatoes.

Further details of the preparation and characteristics of this enzyme will be presented elsewhere.

G. A. Gilbert
A. D. Patrick

Department of Chemistry, University, Birmingham.
Nov. 29.

[1] Hanes, C. S., *Proc. Roy. Soc.*, B, 129, 174 (1940).
[2] Haworth, W. N., Peat, S., and Bourne, E. J., *Nature*, 154, 236 (1944).
[3] Barker, S. A., Bourne, E. J., and Peat, S., *J. Chem. Soc.*, 1705 (1949).
[4] Bourne, E. J., Haworth, W. N., Macey, A., and Peat, S., *J. Chem. Soc.*, 924 (1948).
[5] Gilbert, G. A., and Swallow, A. J., *J. Chem. Soc.*, 2849 (1949).

Control of Cereal Leaf-Miner in Cyprus

The tineid leaf-miner of cereals (*Syringopais temperatella* Led.) is a serious pest in certain areas of Cyprus and also in neighbouring countries, and many attempts in the past to establish control measures, chiefly by cultural methods, have not proved satisfactory, partly owing to the objection of the cultivators to any departure from their customary practices. Duplicated experiments with replicated plots carried out in various parts of Cyprus during the past three seasons have shown that *Syringopais* can be controlled by the use of D.D.T. and benzene hexachloride applied in various ways. The simplest treatment is the broadcasting of a benzene hexachloride dust on the soil at the time of sowing, so that it is mixed with the surface soil when the seed is covered and affects the æstivating first-stage larvæ before they commence attacking the crop. Various dosages have been tested: in the past season the application of a material containing 4·2 ounces of the γ-isomer per acre (294 gm. per hect.) gave spectacular control of a severe infestation on wheat and resulted in a grain yield 227 per cent of the untreated control, confirming similar results in the two previous years.

D.D.T. and benzene hexachloride applied in commercial dusts after the attack on the plants has commenced have given similar results, using the same amount of the γ-benzene hexachloride per acre or a 5 per cent D.D.T. dust at 42 lb. per acre (47 kgm. per hect.). As sprays, 2·6 oz. (73·7 gm.) of γ-isomer or 39 oz. (1·105 kgm.) of a 20 per cent wettable D.D.T. preparation per 100 gallons (454 litres) of water gave similar control, using some 90 gallons of spray per acre (1.000 litres per hect.). It was also found that D.N.O.C. sprayed as a weed-killer gave equally good control of *Syringopais*.

It is thought that the efficacy of D.D.T. and benzene hexachloride is probably due, at least in part, to the habit of the *Syringopais* larva of leaving its mine and re-entering the same or another leaf, its movement thus bringing it in contact with an insecticide on the surface of the leaves. D.N.O.C. appeared to affect the larvæ in their mines.

The simple duster described by Staniland and Major[1] has been found most suitable for use by peasant farmers in applying the insecticidal dusts to the growing crop. These control measures have been demonstrated in many places in Cyprus during the past two seasons and are finding acceptance with the farmers.

The collaboration of other members of this Department in carrying out these trials is gratefully acknowledged. It is hoped to publish a fuller account of this work elsewhere.

H. M. Morris

Department of Agriculture,
Nicosia, Cyprus.
Nov. 21.

[1] Staniland, L. N., and Major, J., *Agriculture*, **54**, 11 (Feb. 1948).

Blood-Group Frequencies in Auckland, New Zealand

Blood samples from 2,802 donors in greater Auckland City were tested for their *ABO* and *Rh* (*D*) groups with the following results:

O	*A*	*B*	*AB*	*p*	*q*	*r*
1,487 (53·07%)	996 (35·54%)	247 (8·81%)	72 (2·57%)	0·2126	0·581	0·7284

84·4 per cent of the total were agglutinated by anti-*D* antisera.

Of 669 *A* bloods, 544 (81·3 per cent) were A_1 and 125 (18·7 per cent) A_2, giving a frequency for *p*1 of 0·1686 and for *p*2 of 0·044.

67 *AB* bloods were *A* subgrouped and 54 (80·6 per cent) were found to be A_1B and 13 (19·4 per cent) A_2B.

The expected frequencies of A_1B and A_2B in the population may be calculated from the estimated values of *p*1, *p*2 and *q*, and these show a reasonable agreement with the observed frequencies.

	A_1B	A_2B
Observed	2·07 per cent	0·49 per cent
Expected	1·94 ,,	0·51 ,,

Godley[1] analysed the *ABO* groups of 1,176 white New Zealand soldiers recorded at the time of mobilization. His figures are:

O	*A*	*B*	*AB*	*p*	*q*	*r*
47·11%	39·28%	10·28%	3·31%	0·2431	0·0712	0·6863

One of us, while engaged in check groupings on soldiers in the Army Transfusion Service in the Middle East in 1943, found an error in the mobilization groupings of up to 10 per cent in the determination of group *O*, due to the use of improperly selected anti-*A* and anti-*B* grouping sera, and to the use of a technique which did not allow the recognition of rouleaux, or prevent false agglutination due to infection. Also, the serum of the individual was not tested for its agglutinin content. Thus the Army groupings were unreliable.

A further deviation of the Army frequencies from the Auckland frequencies given here would probably be expected, as the latter do not represent the whole population of New Zealand.

J. M. Staveley
E. J. Godley

Auckland Hospital,
New Zealand. Nov. 11.

[1] *Ann. Eugen.*, **13**, 2, 99 (1945).

Statistical Studies of Zircon as a Criterion in Granitization

The opposing views of magmatists and transformists have resulted in a heated controversy on the origin of granite, and a recent conference on this question held by the Geological Society of America[1] has stressed the importance of criteria for distinguishing between granite formed *in situ* and granite formed elsewhere and intruded in new surroundings. It has been demonstrated repeatedly that criteria, formerly regarded as incontrovertible, are open to debate. Indeed, there do not appear to be any established criteria which both magmatists and transformists will accept as decisive.

In favourable instances, statistical studies of zircons may yield criteria establishing the type and origin of granite. Such studies include observations on the colour, crystal habit and elongation ratio of the zircons. Elongation – frequency curves[2] of zircons, in particular, may provide valuable clues regarding the origin of granite. Representative results have been obtained by measurement of three hundred crystals for each rock[3]. Zircons of intrusive granites may be expected to consist mainly of sharply terminated prismatic crystals. By virtue of their crystal form, elongation – frequency curves would normally show a maximum at an elongation ratio greater than 2·0. Zircons of sediments, on the other hand, are frequently rounded, and elongation – frequency curves normally show a maximum at an elongation ratio less than 2·0. Static granites formed *in situ* from such sediments may contain a majority of either rounded zircons, or of sharply terminated zircons. In the latter case the granitization series should show evidence of the recrystallization of the rounded crystals to the well-formed, magmatic zircons. Observations made by von Backström and me[4] indicate that zircons may indeed recrystallize under ultra-metamorphic conditions. Two hypothetical examples further illustrate the applications of the method.

In the first example (Fig. 1) granite intrusive into sedimentary rocks has formed migmatites by *lit-par-lit* injection and imbibition. The zircons of the sediments are rounded, those of the granite well-formed and typically magmatic. The migmatites, consisting

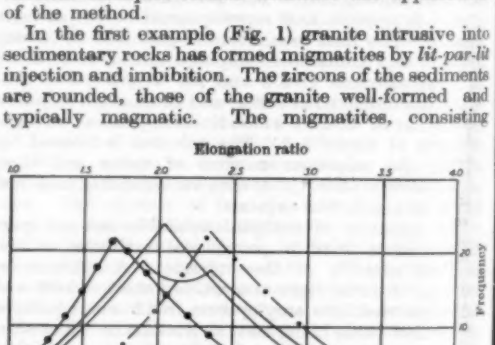

Fig. 1. ●—●—, Intrusive granite; ●—●—, sediment; ———, migmatites

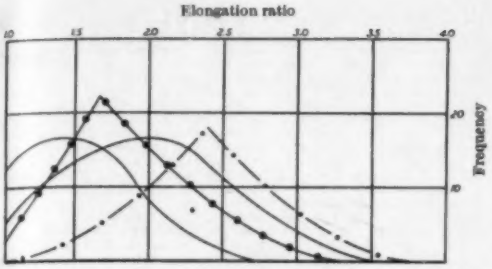

Fig. 2. ● — ● —, Static granite; ●—●—, sediment; ——, granulites

partly of sedimentary, partly of igneous material, contain both types of zircons. Hence elongation – frequency curves show two maxima, which may merge to one maximum at an elongation ratio of about 2·0. Other migmatites, having been formed metasomatically, show zircon elongation – frequency curves with only one maximum, at an elongation ratio less than 2·0. Recrystallization of zircon is nowhere evident.

In the second example (Fig. 2) static granite has been produced by ultra-metamorphism of sediments. The sedimentary zircons are again well rounded, and remain so throughout successive metamorphic grades, until the sillimanite grade is reached. At this stage zircons often exhibit granulation and, by such features as gradual disappearance of colour, peculiar outgrowths and fused aggregate crystals, show evidence of incipient recrystallization. Elongation – frequency curves have ill-defined maxima at progressively smaller elongation ratios. In yet higher metamorphic grades zircons become again larger and better formed, until finally they assume typical magmatic characters. Elongation – frequency curves now exhibit maxima at increasingly larger elongation ratios, finally exceeding 2·0.

ARIE POLDERVAART

Bechuanaland Protectorate Geological Survey,
Lobatsi. Oct. 26.

[1] *Geol. Soc. Amer., Mem.*, 28 (1948).
[2] Smithson, F., *Geol. Mag.*, **76**, 348 (1939).
[3] Dryden, A. L. *Proc. U.S. Nat. Acad. Sci.*, **17**, 233 (1931).
[4] Poldervaart, A., and von Backström, J. W., *Trans. Geol. Soc. S. Africa*, **52**, 1 (1949).

Non-Adaptive Characters

IN reply to my letter asking Dr. Ford whether he had stated at last year's British Association meeting that, in his opinion, no character can ever have a neutral survival value, he stated that it was genes and not characters to which he referred. But he made two distinct statements. In the first, he stated that "genes . . . must *very seldom* [my italics] be of neutral survival value". This can only mean that sometimes a gene *can* have a neutral survival value. In the second statement, he says " . . . every one of these genes has a detectable influence on the viability of the organism", and this means that a gene can *never* have a neutral survival value. Will Dr. Ford tell us which of these statements is correct, for this was the very point on which certain competent geneticists asked unsuccessfully for further information at the Section D meeting? At the same time, will Dr. Ford explain what it is that he means by the adaptation of a gene? The adaptation of a character is something which is easily understood by all biologists; but the conception of adaptation of a gene is surely something that requires further explanation.

H. GRAHAM CANNON

The University, Manchester 13.

A REPLY to Prof. Graham Cannon's letter seems scarcely needed, for it is only necessary to read the statement in *Nature*, **164**, 882 (1949), to which it refers, not as detached half-sentences but as a whole, in order to ascertain the meaning of the two passages he cites. Prof. Cannon quotes, "genes . . . must very seldom be of neutral survival value". It looks as if he had not fully read my letter, since he adds, "This can only mean that sometimes a gene *can* have a neutral survival value". Had he passed to the next sentence, he would have seen the words: "That is by no means to say that they [the genes] are never so, . . ." from which it could scarcely be in doubt that I *do* envisage the possibility that genes may occasionally be of effectively neutral survival value.

Prof. Cannon then goes on to quote a further detached half-sentence from my letter, " . . . every one of these genes has a detectable influence on the viability of the organism" with the comment, "and this means that a gene can *never* have a neutral survival value". In its context, it neither says nor means this. As reference to my letter will clearly show, I am here discussing the many known genes of *Drosophila melanogaster*. I do so to illustrate how rare (not non-existent, as I have already made clear) must be genes of neutral survival value, since every one of the hundreds so far studied influences viability, however trivial may be their visible effects. This, moreover, is exactly what I said at the British Association meeting. In reply, therefore, to Prof. Cannon's specific question, my two statements are in harmony and both are correct. It is important to notice that even though Prof. Cannon has not understood that my reference was to the known genes of *Drosophila melanogaster*, his own deduction from it is still quite illogical. Even if every one of the genes so far studied in the genetics of all organisms had a detectable effect on viability (which is not known to be true), this would *not* mean that a gene can *never* have a neutral survival value: it could not exclude the possibility of a rare situation which had not yet been encountered experimentally.

Finally, I have never once used the concept of the adaptation of a gene, which would presumably involve an adjustment in genic structure relative to the needs of the organism. Prof. Cannon has confused this with the idea that a gene may be of adaptive significance. A gene is not of significance in adaptation if it be disadvantageous or of neutral survival value; a gene may be of use in bringing about an adaptation if its effect is advantageous. The point to which Prof. Cannon presumably refers, though he does not say so, was the question "Can some of the trivial characters often used in taxonomy be regarded as non-adaptive?" My answer was that they may be; but that the genes controlling them are not likely to be non-adaptive. That is to say, such genes will very seldom be of neutral value even when the characters in question are so. The adaptation of a gene was never even suggested, though the adaptation of the *effects* of a gene is a well-known phenomenon which has been studied experimentally.

E. B. FORD

Department of
Zoology and Comparative Anatomy,
University Museum, Oxford.

FORTHCOMING EVENTS

Tuesday, April 11

ILLUMINATING ENGINEERING SOCIETY (at the Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 6 p.m.—Mr. E. S. Calvert: "Visual Aids for Landing in Bad Visibility with particular reference to the Transition from Instrument to Visual Flight".

SOCIETY OF INSTRUMENT TECHNOLOGY, NORTH-WEST SECTION (in the Reynolds Hall, College of Technology, Manchester), at 7.30 p.m.—Mr. Ll. Young: "Pneumatic Relays and their Use in Control Systems".

Wednesday, April 12

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. J. D. McGee: "A Review of some Television Pick-up Tubes"; Dr. E. L. C. White and Mr. M. G. Harker: "The Design of a Television Camera Channel for use with the C.P.S. Emitron".

SOCIETY OF CHEMICAL INDUSTRY, FOOD GROUP (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Nineteenth Annual General Meeting; at 6.30 p.m.—Prof. S. Zuckerman, F.R.S.: "Pounds, Dollars and Calories".

MANCHESTER GEOGRAPHICAL SOCIETY (at the Geographical Hall, 16 St. Mary's Parsonage, Manchester), at 6.30 p.m.—Mr. Peter Scott: "Wild Geese in the Arctic" (Cine Film).

Wednesday, April 12—Friday, April 14

FARADAY SOCIETY (in the New Arts Theatre, The University, Liverpool).—General Discussion on "Heterogeneous Catalysis".

Thursday, April 13

ROYAL SOCIETY OF ARTS, INDIA, PAKISTAN AND BURMA SECTION (joint meeting with the EAST INDIA ASSOCIATION, at John Adam Street, Adelphi, London, W.C.2), at 5.15 p.m.—Mr. Hamid Ali: "Projected Industrial Development in Pakistan".

INSTITUTION OF ELECTRICAL ENGINEERS, UTILIZATION SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "B.S.I. Specifications in relation to Electrical Accessories for Domestic and Industrial Applications" (to be opened by Mr. J. F. Stanley).

Friday, April 14

INSTITUTION OF CHEMICAL ENGINEERS (at the May Fair Hotel, Berkeley Street, London, W.1), at 11 a.m.—Twenty-eighth Annual Corporate Meeting; at 12 noon: Prof. D. M. Newitt, F.R.S.: "Technology and the State" (Presidential Address).

BIOCHEMICAL SOCIETY (in the Department of Biochemistry and Pharmacology, University College, Dublin), at 3.15 p.m.—Scientific Papers.

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Scientific Papers.

INSTITUTION OF MECHANICAL ENGINEERS, HYDRAULICS GROUP (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. H. L. Milner: "Recent Development of the Hydraulic Variable Pitch Propeller".

Friday, April 14—Sunday, April 16

PREHISTORIC SOCIETY (at the University of London Institute of Archæology, Inner Circle, Regent's Park, London, N.W.1).—Conference on "The Older Stone Ages—Recent Trends and Discoveries".

Saturday, April 15

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (joint meeting with the SCIENCES COMMITTEE of the SCIENTIFIC FILM ASSOCIATION, at the University of London Institute of Education, Malet Street, London, W.C.1), at 10 a.m.—Discussion on "Photography and Cinematography by Invisible Radiation".

INSTITUTION OF CHEMICAL ENGINEERS, NORTH-WESTERN BRANCH (in the Reynolds Hall, College of Technology, Manchester) at 3 p.m.—Mr. G. E. Charlish and Mr. E. J. Heeley: "Acid Resistant Vitreous Enamelled Chemical Plant—Some Observations on the Enamel Layers".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

HONOURS SCIENCE GRADUATE to teach Biology to at least Intermediate B.Sc. and First M.B. standard, together with Physics and/or Mathematics to Intermediate B.Sc. level—The Principal, Technical College, Brunswick Road, Gloucester (April 15).

PHYSICIST (with a first- or second-class honours degree) on a specialist staff dealing with physical work connected with gas works practice—The Divisional Manager, West Midlands Gas Board, Birmingham Division, Gas Offices, Edmund Street, Birmingham 3 (April 15).

RESEARCH ASSISTANT (with degree in botany or agriculture) for field experiments on mineral deficiencies affecting crops—The Secretary, School of Agriculture, Cambridge (April 1).

SENIOR ASSISTANT IN ORGANIC CHEMISTRY at the Coventry Technical College—The Director of Education, Council House, Coventry (April 15).

SENIOR SCIENTIFIC OFFICER IN THE NUTRITION DEPARTMENT, for studies of the energy, nitrogen and mineral metabolism of cattle—The Secretary, Hannah Dairy Research Institute, Kirkhill, Ayr (April 18).

UNIVERSITY LECTURERS OR UNIVERSITY DEMONSTRATORS IN THE DEPARTMENT OF ENGINEERING—The Secretary of the Appointments Committee, Engineering Laboratory, Cambridge (April 19).

RESEARCH ASSISTANT (with a degree in chemistry, biochemistry or physiology) IN THE DEPARTMENT OF CHEMICAL PATHOLOGY—The Secretary, Bristol Royal Infirmary, Bristol (April 24).

CHIEF CHEMIST—The Chief Engineer, Colne Valley Sewerage Board, Maple Lodge, Rickmansworth, Herts, quoting Ref. A (April 25).

DEPUTY BIOCHEMIST (with postgraduate training in research and/or considerable experience in clinical biochemistry)—The Secretary, Queen Elizabeth Hospital, Edgbaston, Birmingham 15 (April 25).

LECTURER IN CHEMISTRY (chiefly physical and inorganic), a LECTURER IN PHYSICS, and a LECTURER IN METALLURGY—The Registrar, Nottingham and District Technical College, Shakespeare Street, Nottingham (April 28).

KEEPER OF VERTEBRATE ZOOLOGY in the Museums Department—The Town Clerk, Municipal Buildings, Liverpool 2 (April 29).

LECTURERS IN SCIENCE, and LECTURERS IN MATHEMATICS, at the Royal Military Academy, Sandhurst—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 3020 (April 29).

PROFESSOR OF APPLIED MECHANICS—The Registrar, The University, Sheffield (April 29).

READER IN BIOCHEMISTRY in the John Curtin School of Medical Research—The Administrative Officer in the U.K., Australian National University, 6 Gordon Square, London, W.C.1 (April 30).

DIRECTOR OF THE SOUTH AFRICAN WOOL TEXTILE RESEARCH INSTITUTE—The Secretary, South African Wool Board, P.O. Box 1378, Pretoria, South Africa (May 1).

LECTURER IN GENERAL BACTERIOLOGY—The Registrar, University College, Cathays Park, Cardiff (May 1).

UNIVERSITY LECTURER IN THEORETICAL PHYSICS, and an ASSISTANT DIRECTOR OF RESEARCH IN RADIO-PHYSICS—The Secretary of the Appointments Committee, University Chemical Laboratory, Pembroke Street, Cambridge (May 1).

REGIUS PROFESSOR OF MATHEMATICS in the United College of the University of St. Andrews—The Private Secretary, St. Andrew's House, Edinburgh 1 (May 19).

ASSISTANT LECTURER IN PHILOSOPHY—The Registrar, University College, Singleton Park, Swansea (May 22).

CHAIR OF SOCIAL ADMINISTRATION at the London School of Economics and Political Science—The Academic Registrar, University of London, Senate House, London, W.C.1 (May 22).

LECTURERS (3) IN PHYSIOLOGY—The Dean of the Medical College, St. Bartholomew's Hospital, West Smithfield, London, E.C.1 (May 24).

BURSARIES (2) for research in physical chemistry, at the Imperial College of Science and Technology, and a BURSARY for postgraduate research in the constitution of certain alloys, at the Inorganic Chemistry Laboratory of Oxford University—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1.

CHIEF METALLURGIST, and a PHYSICIST—The British Welding Research Association, 29 Park Crescent, London, W.1.

ENTOMOLOGIST for duty with the Colonial Insecticides Research Unit in Tanganyika or Uganda—The Under-Secretary of State, Colonial Office, Research Department, Sanctuary Buildings, Great Smith Street, London, S.W.1.

HEAD OF THE DEPARTMENT OF PHYSIOLOGY—The Clerk to the Governors, Chelsea Polytechnic, Manresa Road, London, S.W.3.

LECTURER IN CHEMISTRY—The Registrar, Municipal College, Portsmouth.

LECTURER IN SOCIAL PHILOSOPHY—The Registrar, The University, Nottingham.

RESEARCH OFFICERS (male or female) for experimental work on small scale combustion equipment—The Assistant Secretary, British Coal Utilisation Research Association, Randalls Road, Leatherhead, Surrey.

SCIENTIFIC ASSISTANT (university graduate in science or agriculture) for abstracting, indexing, proof reading—The Director, Commonwealth Bureau of Animal Nutrition, Rowett Research Institute, Bucksburn, Aberdeenshire.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Fluid Handling. (Monthly.) No. 1, December 1949. Pp. 44+viii. (London: Binjon Press, 1949.) Annual subscription, 20*s*. [3012

British Museum (Natural History). Economic Series No. 15: Common Insect Pests of Stored Food Products; a Guide to their Identification. By Dr. H. E. Hinton and Dr. A. Steven Corbet. Second edition. Pp. iii+52. (London: British Museum (Natural History), 1949.) 1*s*. [51

Experimental and Research Station, Cheshunt. Annual Report (Thirty-fourth Year), 1948. Pp. 90+4 plates. (Cheshunt: Nursery and Market Garden Industries Development Society, Ltd., 1949.) [51

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 237: Heating in Stored Wheat. By Joan Milthorpe and Dr. R. N. Robertson. Pp. 35. (Melbourne: Government Printer, 1948.) [2812

Nyasaland Protectorate. Annual Report of the Geological Survey for the Year 1948. Pp. 2. (Zomba: Government Printer, 1949.) [2812

Memoirs of the Indian Meteorological Department. Vol. 27, Part 5: Monthly and Annual Normals of Rainfall and of Rainy Days based on Records up to 1940. Pp. 101–298. (Delhi: Manager of Publications, 1949.) 8 rupees; 13*s*. [2812

Records of the Botanical Survey of India. Vol. 15, Part 1: Common Fresh and Brackish Water Algal Flora of India and Burma. By Dr. Kalipada Biswas. Pp. viii+105+10 plates. (Delhi: Manager of Publications, 1949.) 9.10 rupees; 15*s*. [2812